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ECONOMIC GEOGRAPHY

APRIL

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OLIVE OIL

OLIVE oil has ever constituted one of the characteristic attributes of Mediterranean culture. In the rugged lands which front upon the historic sea that give that culture its name, animal fats have been notably scarce. Butter has not played the part in the lives and the health of the people that it has in more northerly lands. The scarcity of good grazing for cattle has limited the amount of suet and tallow. Sheep and goats that can browse their forage from the sparse grass and hard brush have dominated the pastoral industry.

Many of the plants adapted to the exceptional seasonality of the region are high in essential oils, and of these the olive ranks most important in human economy. "Thou anointest my head with oil," a quotation from biblical annals that recurs repeatedly in the literature of the region, reflects a custom of society organized upon the basis of Mediterranean conditions.

As the tallow candle lighted the nocturnal labors of the Nordic workman and student, the Druid priest, and the Anglican monk, so the olive oil lamp lengthened the day for the Judean prophets, the Phoenician cartographers, the Greek artists, the Roman rulers. For food, for bodily comfort, for fuel, and for light, the fruit and the oil of the olive tree have lent themselves to the welfare of the Mediterranean peoples.

ECONOMIC GEOGRAPHY

VOL. 12 APRIL, 1936 No. 2

THE PRESENT SITUATION IN THE WHEAT-GROWING INDUSTRY IN SOUTHEASTERN AUSTRALIA

John Andrews

ON JANUARY 25, 1934, the Governor-General of the Commonwealth of Australia appointed a Royal Commission to enquire into the economic position of the industries of growing, handling, and marketing wheat, manufacturing flour and other commodities from wheat, and manufacturing, distributing, and selling bread. The Commission took evidence and visited the wheat-growing areas in all the states of the Commonwealth and have issued a First Report (July 30) and a Supplement to the First Report (November 27), both of these dealing exclusively with the growing of wheat. Among the findings were the following clauses:

(i) the industry of growing wheat is in a serious financial position;
(ii) the measures of financial relief provided by the Commonwealth and State Governments, and the protection afforded to debtor farmers by legislation enacted by State Governments, have, in the majority of cases, merely helped farmers to reduce their losses;
(vi) many wheat farmers whose main source of livelihood is the growing of wheat have at present little or no margin of assets over liabilities;
(vii) in many cases, interest payments are not being, and cannot be, made;
(viii) the financial difficulties of wheat-growers are producing serious financial difficulties for traders, storekeepers, and others who are dependent upon the industry;
(ix) the situation is especially serious in the areas of light rainfall and variable soil conditions, for the development of which Governments have been responsible and in which they are now the principal creditors;
(xii) wheat-farmers in all parts of the Commonwealth are becoming discouraged, and this discouragement has been accentuated in many instances by the fear of dispossession.

These findings put into official words and brought forcibly before the notice of the public a situation which had long been the source of anxiety to those interested in the wheat industry; one, moreover, which presented a most difficult problem to the administrator, since all suggested solutions involved radical and far-reaching changes of policy and economic structure. The recommendations of the Commission, set out in the November report, were briefly as follows:

(i) a sum of £4,000,000 to be provided by the Commonwealth Government for the relief of wheat-growers. This sum to be partly provided by an excise tax on flour and the remainder from Government funds;
(ii) a bounty of 3d per bushel of marketable wheat and a payment of 3/– (approximately) per acre of wheat-sown land to be paid to all farmers;
(iii) the remaining portion of the original £4 million after the above payments had been made to be granted as relief to wheat-farmers "who have experienced specially adverse farming condi-

tions during the present wheat year (1934)";

(iv) an excise tax to be levied on flour manufactured and consumed in Australia so as to maintain the price of flour at £12 per short ton delivered Melbourne; the proceeds from this tax to supply portion of the £4 million previously referred to and to provide assistance in future years to wheat-farmers.

The acceptance of these proposals involves far-reaching changes in policy: it would mean that the wheat industry would join the group of protected and bounty-supported industries, and that the wool-growing industry would then be the only industry of importance outside the group. In addition, the home price of wheat to the ordinary consumer (in the form of bread) would be raised from below to above the world parity price; farming in the areas of precarious cropping would receive another encouragement from official sources, when, possibly, other counsels would indicate abandonment; further taxation burdens would be laid on the Australian consumer, and, according to one view (see Appendix A on the home price, in the Supplementary Report, by Professor Giblin), would mean increased costs of production for the farmer.

In view of these considerations, and of the presence of related problems in all the principal wheat-exporting countries, it seems opportune to review the conditions under which wheat is grown in Australia, and particularly to examine carefully those areas in which wheat-farming (in the language of the Report) is in a precarious and critical state. The following paper sets out the geographical conditions in the most important portion of the eastern Australian wheat belt, the area lying between the Sydney-Broken Hill railway in central New South Wales on the one hand and the Lower Murray River on the other. Special attention is paid to the fringe areas where the economic and administrative problems are most acute. The area covered is one of which the writer has field knowledge, and the problems dealt with are those which are to be found throughout the belt. First are discussed the different types of country in which wheat is being grown and the distinctive farming opportunities of each type; there follows a discussion of the climatic factors and their importance in the fringe regions and the regions of possible extension; finally the economic position of the wheat-growing industry is reviewed.

FIGURE 1.—The distribution of wheat-growing in Australia. (Map prepared in the Department of Geography, University of Sydney.)

THE WHEAT BELT

The wheat belt of southeastern Australia contains the greater part of the agricultural lands of the Commonwealth (some 65%). It is extremely homogeneous as regards crop-growing since at least 75% of the cultivated area of the belt is under wheat; the only other crops grown within the belt (excepting those of the irrigation settlements along some of the larger streams) are oats and lucerne (alfalfa), the former as a rotation and fodder crop, the latter in small quantities only as a fodder crop for the farm animals. In some of the more recently settled areas

crop-specialization has reached its limits; Coolamon Shire in New South Wales, for example, has 93% of its cultivated area in wheat; Carrathool Shire, on the fringe of farming in New South Wales, has 95%; Millewa, a fringe county in Victoria, has 90%. The wheat belt, then, is monocultural, with cultivation and specialization indices for its various divisions higher than those of any other crop zone in Australia.

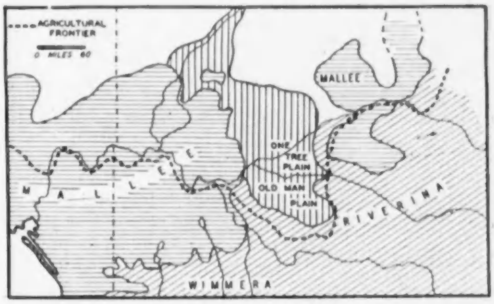

FIGURE 2.—Distribution of the three major regional facies. The position of the agricultural frontier is also shown. See Figure 19 for location of chief towns.

The Murray-Darling Basin, in which lies the southeastern wheat belt, is rimmed on its eastern margin by a series of highland blocks. The streams forming the main systems, that of the Murray and that of the Darling, rise on the mature surfaces of these blocks, flow through a rugged zone of gorges along the highland edge, then traverse a zone of rolling "slopes" abutting the blocks, and finally cross a relatively very wide zone of gently-sloping plains. The plains represent a geosyncline within which deposition has gone on since cretaceous times in what was then a shallow sea. Continued deposition built out the shoreline of this sea, and with the raising of the surface above sea-level there followed the engrafting of the drainage lines to give the Murray-Darling system of the present. Subsequently to this came an arid period when the rainfall and the flow of the rivers decreased; the lower courses silted up and distributaries formed, while no new tributaries were formed along the lower portions of either the Darling or the Murray. In northwest Victoria and along the Murray in South Australia many streams draining towards the Murray were unable to keep their channels clear of encroaching sand and, with their own flow diminished, they lost themselves in the sand-dunes that had developed. Recent times have seen some slight amelioration in rainfall conditions resulting in the spread of river alluvium from flooding rivers in the western Riverina, the vegetating of the sand-dunes, and the spread of a semi-arid woodland.

The wheat belt lies along the "slopes" and the adjacent portions of the plains, where the topography is suitable for extensive mechanized agricultural practices and where the optimum climatic conditions for the wheat plant obtain. On the eastern margin the boundary of wheat cultivation is not well marked; wheat is grown in small quantities on the highlands and even in the coastlands. On the western or arid margin the boundary is much more definite: its position is shown in the accompanying map (Figure 2).

REGIONAL TYPES

The present belt covers a fairly wide variety of regional types. There are great differences between the sandhill country of the Outer Mallee and the mature slopes of the eastern Riverina. Variations in climate, soil, landform, and drainage all enforce different cultural methods; the farmer is confronted with new problems and is offered new opportunities; each region has its distinctive troubles and promises. The first step is to distinguish these regions and to review their wheat-growing potentialities. Three major regional facies may be readily discerned, the

FIGURE 3.—Wheat field in the Riverina; originally pine-box country. Some of the pine (*Callitris robusta*) is left standing to give shade to sheep.

Riverina-Wimmera, the Mallee, and the Old Man Plain facies. (The term facies is here applied to regional entities where the distinguishing factors are the surface distributions of soil and vegetation.)

(*a*) *The Riverina-Wimmera facies* has a typically savannah woodland formation. The most characteristic trees in the Riverina are the so-called pine (*Callitris robusta*) and the box (*Eucalyptus hemiphloia*) and one speaks of the pine-box association; in the Wimmera the buloke (*Casuarina Luehmanni*) is typical. The soils in both regions are red-brown earths; they are usually loams or clay loams, are fairly deep and easily worked, and have a subsoil rather heavier than the topsoil. They vary somewhat, but only within relatively narrow bounds. The value of the land can be estimated very largely from the type of vegetation found thereon: thus the wheat-farmer thinks very highly of land carrying both pine and box; the soils in this type are usually very fertile, deep red, light to fairly heavy loams. Areas in which pine occurs alone and in which box occurs alone are both good wheat country: the latter has usually a rather heavier rainfall than the former and the soils, insofar as one can generalize, are darker in color and heavier in texture. Country carrying buloke and belar (*Casuarina lepidophloia*) contains heavier soils again and, though fertile enough, is not so popular because of the additional labor involved. Belar occurs alone in country which has very heavy and rather alkaline soils, and the surface is often pitted with "crab-holes," depressions about 10–12 feet in diameter and 3–6 feet deep; these depressions make ploughing difficult for some years until continued cultivation fills them in. All these soils are capable of producing good wheat crops when due regard is had to the special qualities and cultural requirements of each; in fact they have all been successfully occupied by farmers since the last decades of last century and the farms have settled down to an orderly routine; there is little unused farming land of any value except that which is still being used exclusively for sheep-raising. There are farmers in the region who in pre-depression times were not making a reasonable return, but this is usually due either to the personal inefficiency of the farmer or to some error in farm organization, as for instance at Finley where the size of the farms as subdivided by the Government is considered too small for efficient working: only in exceptional cases is the fault in the quality of the land or the physical conditions.

Since 1890 these areas have been the granaries of eastern Australia. Settled primarily as sheep-runs, they have seen a progressive breaking-up of the large pastoral holdings into sheep-wheat farms varying in size from 500 to 2,000 acres. Since the introduction of the use of superphosphate manures the yields have increased steadily and they are now the highest in the Commonwealth; many Wimmera farmers can show crops of over 40 bushels to the acre, which is a very high figure indeed for Australian

farming. Most of the State experimental farms are in these regions and from them has emanated a steady stream of knowledge and better cultivation methods. There are definite water-channels through most of the area and both the Riverina and the Wimmera are crossed by large streams which supply water for the stock and for riparian irrigation. One might say that the major problems of the utilization of this region are solved or in process of solution. It is only under exceptionally adverse climatic conditions or after periods of unduly inflated land values that the farmer of average skill finds himself in financial difficulties.

(*b*) *The Mallee facies* takes its name from the dominant vegetation association. The mallee is a dwarf eucalypt (*Eucalyptus dumosa, E. oleosa*) with a distinctive habit of growth with branching arms from the common "root-stock"; the branches are bare except at the top where the leaves give a canopy-like shape. The wide extension and the relative pureness of the mallee stands have led to the name of the tree being given to the surrounding region, so that we have the "Victorian Mallee" and the "Murray Mallee" of South Australia. Within the Mallee facies may be found, besides the mallee, several other associations, namely, areas of pine and box, of pine and belar, of belar and wilga (*Geijera parviflora*). The mallee is not usually found associated with other trees and it is very important to note that there is usually no undergrowth in areas of mallee. With other associations there is usually a cover of annual grasses. Porcupine grass (*Triodia*) may occur on the borders of mallee, and saltbush (*Atriplex*) and other halophytes are to be found in the salt-flats.

Mallee country is usually associated with sandhill country. In Victoria and South Australia the mallee areas are areas of rolling plains on which the undulations represent an ancient dune system. Between these undulations or "sandhills" are the "flats," often very salty as to soil, even to the extent of having a surface incrustation, and carrying saltbush. In New South Wales, on the other hand, most of the mallee areas are level plains with only occasional rises. The soils in the facies belong to the general group Mallee soils which are "the most alkaline of Australian soils." They are light-red and brownish in color and are light in tex-

FIGURE 4.—Riverina facies in the Wakool district; chiefly white box (*Eucalyptus hemiphloia*) timber. Only a very small area of the Wakool district is under cultivation.

ture: sometimes they are mere sand, as in the area around Dimboola, and then their yielding power, except in years of very low rainfall, is relatively very low. One of their characteristics is the concentration of calcium carbonate in the subsoils; it has been suggested that much of this is derived from salt-bearing off-ocean winds. However this may be, many areas have rubble limestone so close to the surface and in such quantities that the soil there is a grey limestone powder which very readily absorbs moisture. In other parts there is sheet-limestone underlying the topsoils at depths from three feet down; in this case the limestone acts as a sponge. As Prescott and Piper have pointed out, the mallee soils are generally found in regions of low rainfall per wet day, which allows of little leaching, high penetration, and no run-off. On the other hand most of the mallee areas are traversed by large streams rising in and deriving their water from the highlands and from these it has usually been possible by some means to supply stock and domestic water. Moreover, certain portions of the New South Wales mallee, of northwest Victoria, and of the South Australian Mallee have artesian resources.

The mallee areas have seen the most recent and the most spectacular advances in wheat-growing in eastern Australia. During the eighties of last century the mallee areas of Victoria contained only a sparse population of sheep, and mallee land was dubbed "desert" by pastoralist and farmer alike. But a remarkable change in the appreciation of this country came about in the nineties when in South Australia the mallee-roller and the stump-jump plough were invented and the first farmers began to cultivate mallee lands. It was found that under light rainfall conditions they were capable of producing crops when the older-established areas experienced failure; the land was obtainable at very low prices, and the wheat-market was expanding. "Once it was discovered that the soil was admirable for agriculture, once the German settlers had trekked overland to Warracknabeal and Chaffey had started irrigating Mildura, settlers poured in. Despite the drought 60,000 people were there by 1898, and its very heart saw experiments in tenant farming. 'The Little Desert' round Dimboola fell; and, since then, terms like 'the Inner Mallee' denote the passing of attention."

In the same way few people foresaw the change which came over the agricultural fringe in New South Wales during the second and third decades of this century. Before the War geographers, administrators, and farmers alike thought that most advance would be made on the northern side of the wheat belt from Coonamble to the Queensland border; yet in the subsequent fifteen years the acreage under wheat increased twenty times, to 100,000 acres, in the Hillston and Cargelligo police-patrol districts in the central west, and only four times or less in areas of similar size in the north.

The first people who entered the Victorian Mallee as farmers in the eighties and nineties were pioneers in every sense. In most cases they fought a bitter and disheartening fight against heavy odds of strange conditions and against drought and sand. Many were broken and abandoned their holdings, but there were always others to take their place, and in the second and third generation the land was tamed and brought under control. By the war years the Inner Mallee was furnished with a group of flourishing towns and attention was being turned to the Outer Mallee; railways were being pushed to the Murray and New South Wales was

FIGURE 5.—Mallee country, west of Annuello, Victorian Outer Mallee; the undulations of the "sandhills" can be discerned.

awakening to the value of her own mallee. When the war was over, the soldiers returning to work, and wheat prices still high, the most important movements toward opening these New South Wales areas took place. A wave of optimism swept the country and the "Million Farms Scheme," the outcome of a Royal Commission on the Agricultural Industry, was sponsored to provide for the opening of the mallee country at the junction of the Darling and Murray Rivers. Ungarie, Cargelligo, Rankin's Springs, and Hillston in the central west were quickly occupied. Some uncleared mallee land near Hillston was sold by the pastoralist owner, to whom it was of little value, to wheat-farmers at £3.10.0 per acre, and equally fantastic prices were paid throughout the region. But there the advances halted. Wheat prices fell and continued to fall, poor seasons came, and many farmers found their returns out of proportion to the capital invested. The Darling scheme was forgotten, and though spasmodic action had been taken in examining the Roto Mallee with a view to settlement, and a railway was built from Hillston to connect with the Broken Hill line at Roto, the depression of 1930 shelved the scheme. The run of bad seasons from 1927 to 1930, and the unprofitable prices of the last few years are likely to dam back the wave for many years. Despite this dry spell and despite the depression itself, these fringe farmers still believe in their land; the complaints they have are against faulty administration or low prices, and not against the land itself. This is understandable when one knows the history of some of the new districts, and how some fortunate farmers have made small fortunes through a luckily-placed run of good years and a quick sale of the farm-holding. Most of the farmers, too, have experienced at least one bumper crop with a yield of twenty-five to forty bushels per acre and these experiences are spurs which carry one past many lean years.

During the year 1931 mallee country produced between 20% and 25% (so near as one can estimate from the statistics) of the total eastern crop of 160 million bushels at an average yield of 9 or 10 bushels per acre. Detailed figures can be quoted to show that much of the mallee country has a fairly high productivity, and in Victoria and in some of the South Australian Mallee settlement has passed the pioneering stage and is definitely established. As we shall see later, however, the outer boundaries of the mallee are very close to, if not beyond, the economic limit of profitable cultivation, and they also come close to the geographical limit determined mainly on the basis of physical conditions.

In all mallee country there are certain inherent difficulties for the farmer in the nature of the soil and the vegetation cover. These are the difficulties of clearing, efficient cultivation, drift, and salt.

Owing to their peculiar habit of growth, mallee trees are not felled in the ordinary manner, but are "rolled" and burned. The tree is formed of a shallow-rooting "shield" from which shoot off the individual branches; the latter are usually some three or four inches in diameter, but in the larger species may

be up to eight inches. The branches can be easily disposed of by rolling down with a wooden or iron roller and by burning after they have dried, but the shields still remain in the ground and each year, if not removed, will put forth fresh suckers. The method of removing the shields or roots is usually as follows: the rolled and burnt-over area is sown with wheat by means of a "stump-jump combine," which also pulls a proportion of the shields to the surface where they are collected; the stubble of the resultant crop (and the new suckers) are then burned; and by repeating the process for several years the suckers are destroyed and the shields are worked to the surface and collected. It will be seen that for three years at least the mallee farmer cannot hope for heavy-yielding crops, and indeed mallee farms reverse the usual process of "decreasing returns" by reaching their maximum only some ten years after the first sowing. In the areas carrying pine and other trees the timber is valuable for fencing purposes, but mallee itself has no such value, although the shields make excellent fuel and are sometimes sold to the cities as such.

In the second place, the best methods of cultivating mallee soils have not yet been discovered. They bear very well under light rainfalls, but they obviously need fallowing, and various systems, particularly that known as the "mallee rotation" (wheat, pasture, bare fallow), are in vogue. The best cultural methods have not yet been discovered; even in the methods of working the soil there is much divergence. Some farmers plough to depths of four inches and others barely scratch the surface. There is great local variation in mallee soils, and each variety calls for different treatment; the limestone soils bear heavily in wet seasons, but burn off in dry years while the more sandy soils have the opposite tendency. Most of the southern mallee areas are undulating and slopes have been cultivated which, considering the light texture of the soil, should have been left in timber. Moreover the sandy country cannot be cultivated in fallow as often as is desirable because of the resultant drifting.

FIGURE 6.—The Victorian Inner Mallee near Boort; this has been settled for some fifteen years. The dark-colored fields on the left are burnt stubble. In this district the old dune system is very regular, the ridges spaced about a quarter mile apart with an east-west axis.

Drift is a very serious problem in Western Victoria and in South Australia. The region is subject to strong northerly and northwesterly winds in spring and summer, and once cleared there is everywhere a certain amount of

soil movement. In some areas, particularly those with lighter soils and more pronounced sandhills, the movement is amazing, and whole fields have been deprived of their topsoils, fences and roads have been covered, water-channels blocked, and agricultural values much reduced. Clayton remarks that "in dry windy weather so much is blown away that one farmer had eleven sheep smothered in a corner of his fallow during a dust-storm." In new country there are now regulations to insure the preservation of windbreaks, but much of the damage has already been done.

It has been stated that the mallee soils are alkaline, and under certain circumstances this is definitely a disadvantage. Salt patches of some feet in diameter are likely to appear in the fields and within them there is little crop-growth. Some of the features of their appearance in the higher fields are not understood, but in the salt-flats they are due to seepage from the surrounding slopes. In the irrigation settlements of the Lower Murray which are on mallee soils (e.g., Mildura, Red Cliff, Coomealla) there is always trouble with salt. However, in the wheat zone the trouble is at present marked only in South Australia.

These mallee areas dealt with above include all the country of "light rainfall and variable soil conditions" in which farming is "in a precarious and critical state." Before we reach final conclusions regarding the areas it will be necessary to deal in later sections with the factors determining yield (climatic) and the factors determining farmers' returns (economic). It will be seen, however, from the foregoing description that the farmer has met certain fundamental difficulties in the cultivation of these mallee areas that make his position very different from that of his confrere in the older-established areas.

FIGURE 7.—Mallee near Hillston, New South Wales. There are very few sandhills in this region. Note the absence of grass cover typical of mallee country.

(*c*) *The Old Man Plain facies* shows characteristically an open plain. The soils are relatively heavy and represent flood-alluvials of the larger Pliocene rivers. The areas are practically treeless, the main plants being saltbush, cottonbush (*Kochia*), and grasses (*Astrebla, Stipa, Andropogon*). Along the watercourses, however, are to be found lines of red-gums (*Eucalyptus rostrata*) where their roots can get down to water.

FIGURE 8.—Wheat-farmer's dwelling, near Hillston, New South Wales. This is one of the more prosperous farms on mixed mallee and pine land.

The plains are often very extensive, and may stretch round the horizon with only a distant line of red-gums to break the monotony; they appear dead-level to the eye except during the hot summer days when mirage plays its tricks. The soils are mainly heavy alluvials which crack when dry and heated; they can be rolled very hard and form excellent road-surfaces during the dry weather, but in wet weather they are almost impassible. Some areas of salt accession are to be found in these areas and are mainly sub-surface effects. In Victoria the grass steppes fringing the northern rivers (Loddon, Campaspe, etc.) have had channels constructed through them from these rivers and they are irrigated for pasture-improvement.

The gray-soil areas, such as these plains, have not been utilized for wheat-growing on any noteworthy scale. The soils show a high proportion of clay and represent, in their riverine portions at least, the accumulated deposits of river flooding. Agriculturally they are somewhat heavy and they do not yield moisture as readily as do the mallee soils. They are more difficult to cultivate when wet, but there is on the other hand no preliminary clearing of the land. Also they are excellent pasture lands, but this means that they are in the hands of the pastoralists, and that they would be therefore more difficult and more expensive to acquire for farming than are the mallee lands. The struggle between squatter and farmer still rages intermittently over such areas. It is almost certain that they will not be used for farming until all other available land has been occupied.

The general distribution of these three facies is shown on the accompanying map (Figure 2). Boundaries between them are usually sharp, but sometimes, as, for instance, along the watercourses running through the mallee where there may be found extensions of the grass-lands, there is a certain amount of inter-penetration. There are also several much less extensive and less important facies; along the Murray in its lower course is a series of swamps which are being reclaimed to form valuable irrigation settlements; in the northern portions there are several hill-ranges which introduce variations into the biogeographic distributions of the surrounding districts; but none of these or others are important from our present point of view, and they do not affect the validity of the foregoing division. The three facies described include all the wheat country of the central and arid portions of the wheat belt, and also practically all the country into which wheat is likely to spread in the near future within the area under discussion.

THE CLIMATIC FACTORS

In eastern Australia agricultural opportunities are determined firstly by the topography and soil, and secondly by climate. One of the most serious mistakes made by writers computing the potential cultivable area has been to ignore this order of importance, either by leaving the soil factor out of consideration or by putting the major emphasis on climate. A knowledge of the history of agricultural development shows that the topography-soil factor has been of paramount importance

throughout the continent. Nevertheless, when the topography-soil factor has determined what lands may be used for wheat-growing, the climatic factor usually decides whether yields will be sufficiently high to make wheat-growing profitable.

The present-day climates of the southeastern wheat belt include two main types. In common with the rest of southeastern Australia, the eastern portions of the plains show the type classified as a C type under Koppen's system; most of the southern area shows the variety Csa, but in northern and central New South Wales the variety is Cfa. On the other hand the interior portions of the plains belong to the B type, the most common variety being BSks. In the first case these symbols connote a warm temperate climate with a well-defined summer drought (Csa) or similarly warm climate with uniform distribution of rain through the year (Cfa); in the second case they connote a dry warm climate with semi-arid characteristics and a summer absence of rain (BSks).

Most of the wheat belt lies in the zone of winter-maximum rainfall. The concentration of rain is nowhere very marked in either New South Wales or Victoria, but it is nevertheless a very important factor. The map (Figure 13) shows the seasonal concentration of rain for Australia. (A series of seasonal maps are given in J. Andrews and W. H. Maze, "Seasonal Incidence and Concentration of Rainfall in Australia," Proc. Linn. Soc., N. S. W., Vol. 58, 1933, p. 121.) It will be noticed that there is an increasing tendency to seasonal uniformity as one comes north through the wheat belt from South Australia, through Victoria to New South Wales. This is a very important factor in wheat-farming, for cultivation methods must change considerably as one comes out of the zone with a summer drought into one with a well-pronounced winter fall. The boundary between the winter and the summer types in the eastern wheat belt lies in mid New South Wales.

Another important map (Figure 14) is that dealing with aridity. It shows the mean duration (number of months) of the period during which arid conditions are experienced, or in other words, the mean length of the period when the monthly index of aridity (precipitation in millimetres divided by temperature in degrees Centigrade plus 10) is less than 1. It will be seen that most of the wheat belt experiences an arid period though in central and northern New South Wales it is brief. South Australia and northern Victoria have arid

FIGURE 9.—Sand drift in the Outer Mallee. These drifts are blocking the roadway and represent topsoil blown off a ploughed field to the right of the picture.

periods of more than four months and in some places of more than six months. In these regions the position of the humid months with reference to the monthly march of temperature is highly important for the wheat farmer. We have still much to learn about the incidence of aridity in Australia; but the line of eight months duration of the arid period is undoubtedly significant in marking off the mean position of the arid border of farming. At present there is no cultivation outside this border, and it coincides fairly well with the humid boundary of the "acacia scrub and shrub steppe" which is definitely an arid association. We do not know much about the frequency of occurrence of arid periods longer than the normal: it is these, of course, which constitute the "dry years," the years of crop failure; but we can say from this map that the areas which lie in the most dangerous zone are Eyre's Peninsula, the northern parts of the Murray mallee and the outer Victorian mallee. In these regions the average length of the arid period comes near to the critical length (eight months) above which arid conditions prevail permanently in spite of the presence of a short humid period.

This brings us to the question of the reliability of the rainfall. Several methods have been devised for dealing with this; the accompanying map is built on a method devised by the present writer and shows the index of reliability of annual rainfall amounts, based on the frequency of occurrence of the most frequent amounts ($R=100\ f/y$, where f is the number of occasions on which the most frequent value occurs and y is the total number of years on record). The impressions made by these annual indices need to be amplified by considering the monthly figures, but the map brings out the point that the southern wheat areas have somewhat more reliable annual figures than have the northern: the difference is to be correlated with the difference in seasonal concentration and with the increased amount of summer rainfall in the north. This summer rainfall is a very variable quantity in these latitudes and is relatively reliable only in the coastal areas of Northern Australia; it often comes in the form of localized thunderstorms which are too restricted in area and too violent to be of importance for the crop planted in the following autumn, though the occasional linking-up of a tropical low-pressure trough with a "southern" cyclone gives heavy summer rains all over the wheat belt. The map (Figure 15) shows the general effect of these summer tropical influences by the very pronounced trough

FIGURE 10.—A salt-flat in the Outer Mallee, between two sandhills. The flat has a surface incrustation of salt and carries halophytic shrubs. Such areas are of course useless for agriculture.

developed in eastern Australia in the annual reliability isolines.

It is most important that the farmer should know the amount of monthly rainfall which he is likely to receive. Several methods of estimating rainfall reliability are in use, but most of them fail when applied to monthly totals over a wide range of climatic types. The following method provides a workable basis. The first step is the determination of the most frequent monthly rainfall amount, this being the central figure of that group which, with a given percentage range about the central figure, occurs most frequently in the record. The number of times the figures of the group occur in the record is then expressed as a percentage of the total number of recorded figures and is a measure of the reliability of the rainfall. Thus in the case of Albury in January it would be found that the group with a central figure of 200 points (20 inches) (with a range of ±50%) contains 50% of the recorded rainfall occurrences, this being the largest group of similar range. It may be said then that in this case Albury in January has a most frequent rainfall of 200 points and that the reliability index is 50.

The most frequent amounts and the reliability indices may be graphed (Figure 16) so as to give a comparison of conditions at various stations. It will be seen readily from these graphs that both the monthly amounts and the reliabilities decrease from east to west, and also that the northern areas show lower falls and reliabilities in the winter months and a greater uniformity throughout the year than do the southern areas. These features support the evidence of the maps given above; but in addition they illustrate this very important fact that the season of winter rains and high reliabilities becomes much constricted in the western areas. For example, not only are the rainfall and the reliability lower at Hillston in the April-October period than at Wagga (on the humid edge of the wheat belt), but Hillston also experiences a much more abrupt transition from rainy and reliable conditions to a period of scanty and unreliable falls. This is extremely important for the wheat farmer, for, as has been previously stated and as Barkley's work has shown (see H. Barkley, *Wheat and Grain Review*, Sydney, Aug. 1928), it is very largely the amount of rain in the planting months (April-

FIGURE 11.—Grey soil plain at Jerilderie, New South Wales. These provide excellent pasture, usually for stud merino flocks. The trees, river red gum (*Eucalyptus rostrata*), are found only along watercourses or in "soaks."

May) and the seeding months (September-October), and particularly the latter, which determines the yields. The fringe farmer therefore has to contend not only against low rainfalls but also against the early cessation of the rain in the most important period of the plant's growth. It has been estimated that at Hillston, for example, the farmer is likely to obtain a successful crop in one year out of three, considered over long-term periods. (See J. Andrews, "Pioneer Farming in the Hillston District, New South Wales," *Australian Geographer,* Vol. 2, No. 1, p. 36). The following table illustrates the conditions in the period 1926–31:

TABLE I

Police-Patrol District	Year	Rainfall in Points								Yield Bus./Ac.
		Apr.	May	June	July	Aug.	Sept.	Oct.	Apr.-Oct.	
Hillston		202	149	216	108	184	94	13	966	12.5
Cargelligo	1926	272	227	293	67	157	72	28	1116	14.9
Hillston		5	27	46	69	52	103	203	505	0.2
Cargelligo	1927	68	29	28	33	78	142	230	608	0.02
Hillston		188	94	121	122	13	35	114	687	3.7
Cargelligo	1928	103	71	148	238	14	43	156	773	9.4
Hillston		162	12	15	105	224	73	238	829	3.0
Cargelligo	1929	249	21	35	71	128	175	54	733	3.7
Hillston		34	103	236	89	114	53	384	1013	3.3
Cargelligo	1930	132	88	352	125	86	27	435	1245	5.4

Even more rigorous conditions obtain in the fringe areas of the Victorian and South Australian mallee, for it must be remembered that here the summer drought is more pronounced.

On the other hand in the older wheat belt the rainfall has been proved to be sufficiently ample and reliable to insure success in any but the unusually dry period. Even then it is rare to experience complete failure of crop of the type shown in 1927 in table I. This can be shown more definitely with the use of concept of "climatic years" made familiar by recent work. (See R. J. Russell, Publications in Geography, University of California, Vol. 5, No. 5, p. 245; H. M. Kendall, *Geographical Review,* January, 1935, p. 117.) It has been shown above that the boundary of the older wheat belt (what may be called the "safe zone") is to all intents and purposes the boundary of the savannah woodland and red-brown soil region. On the other hand it has been shown that no successful farming has been carried on in the region of the acacia scrub and shrub steppe. If, then, the mean precipitation-temperature data for these boundaries are determined and compared with the annual precipitation-temperature data for relevant stations in the wheat belt, the relative frequency of the two climatic types at those stations can be stated. Thus Wagga for the period 1901-30 experienced in every year (except 1902) more humid conditions than characterize the mean year of the "safe zone" boundary; Hillston on the other hand experienced some eight such years, and fourteen years which were more arid than the mean years of the acacia scrub boundary. Finley had "safe years" in eighteen out of thirty; Wentworth had arid years in seventy-five percent of the total period. These frequencies are shown in Figure 17.

Figure 18 shows the rainfall and reliability indices mapped for the wheat belt of the southeast to show mean conditions in the period between April and October, the wheat-growing period. By far the most important isoline is the 750 points isohyet outside of which no wheat is being grown. The next most important line is the 1000 points isohyet which is the arid boundary of the country we regard as the older wheat belt. Between the two is the scene of all the

struggle to establish farms—the pioneer farming fringe.

Now, experiences in South Australia have shown that under present conditions of agricultural methods and of farm economics the 750 points isohyet very definitely represents the limit for wheat-growing; in Victoria and New South Wales, where the reliability is slightly less, this line has not yet been reached. In the latter State there is a certain amount of summer rainfall which adds to the supply of soil moisture, but on the other hand the temperatures are also higher and so the effective precipitation less. At the present time this 750 isoline is another Goyder's Line, "an iron band constricting settlement"—and no responsible opinion advocates farming settlement outside it.

In the fringe area (receiving 750–1,000 points in the growing season) the position is more hopeful. The examination of the data given in the maps shows that the farmer can count on more than 750 points in the growing season in rather better than three years out of ten, and on Barkley's figures this would result in a crop of 8–9 bushels per acre in Victoria. Unfortunately we have no similar formula for New South Wales. However, all our lines of evidence point to the fact that the fringe can expect, over long-term periods, good crop years for slightly better than three years out of ten. There will, of course, be long "runs" of good years and long "runs" of bad years (e.g., 1927–32 in the New South Wales fringe); also local conditions of soil fertility and soil type make it impossible to give precise statements to cover the whole area. Nevertheless, it will be seen that these areas can undoubtedly grow wheat successfully in good years, but that, with the high frequency of crop failures, the average long-term yields are low enough to make the economic position doubtful.

FIGURE 12.—Grey soil plain along the Loddon, Northern Victoria. In the foreground is a water-channel by means of which water for stock is brought from the river.

A method of combining the charts and comparing various districts is given in Figure 19 which shows a regional grouping. The basis of the comparison adopted is a primary division into those areas with 60 index of reliability in more than one of the winter months on the one hand, and on the other those areas with lesser reliability than this; secondly into those with less than 750 points between April and October, those with 750 to 1,000 points, those with 1,000 to 2,000 points, and those with more than 2,000 points. Combining the criteria we get the five regions shown.

Region 1 is not likely to come under cultivation in the predictable future. Rain is very low and erratic, it is every-

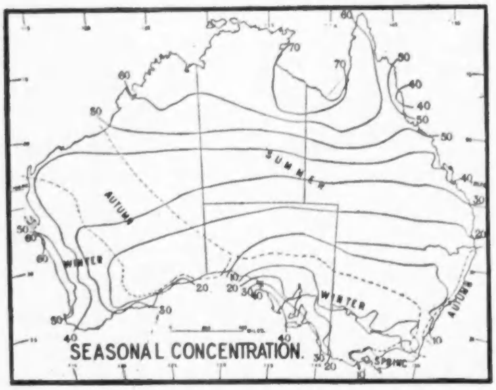

FIGURE 13.—The isolines on this map show the degree of seasonal concentration of rainfall; the index figure is the difference between the highest and the lowest seasonal percentage amounts; the higher the index the more concentrated is the rain. The season of maximum rainfall is also shown.

where less than 750 points between April and October and the reliability index is always less than 60; wheat has never been tried within the area on a practicable or continued scale, and the characteristic soils and vegetation (grey-brown earths or desert-steppe soils; acacia semi-desert and shrub steppe) are outside the range of agricultural experience. The region has an average length of the arid period of more than eight months, a very high average. Reports of isolated crops grown in this region under special conditions can be of little value in a discussion dealing with the region's suitability for extensive farming.

Region 2 appears to have slightly higher rain totals than the adjacent country across the Murray, but reliability is less. This is the Wentworth mallee region, a continuation northwards of the main mallee body of Victoria and South Australia. It is traversed by the Darling and by some of the distributary channels of that stream. It is in many respects similar to the adjacent Victorian regions, though sand-dunes and drift are on the whole less noticeable. Mainly because of this propinquity, and because of the successes of the heyday of mallee settlement in Victoria, there has always been a certain amount of interest in the Wentworth country, and this culminated in 1920 when the report of a committee appointed by the Parliament of New South Wales to inquire into the conditions and prospects of the agricultural industry was made public. In a subsequent political election campaign the area figured prominently as the locus of the "Million Farms Scheme." Opinions differed—and still differ—widely as to the possibility of settling the area. Heaton says "'A million farms for a million farmers'—a slogan so mad that it should have laughed its author out of public life into an asylum." On the other hand men of experience in the area speak highly of it. (See Mr. Granter's evidence in the Report of the Committee on Agricultural Industry, Parliamentary Papers, N. S. W., 1921.)

From the map of rainfall-reliability it can be seen readily that it ranks behind the Roto area in potential capacity and the inference is that it should not be opened for settlement until the latter has proved its worth. The rainfall is low and quite variable and prospects of profitable cultivation would be small under existing conditions of prices and production costs. The second serious disability is the absence of transport facilities. There are no railways in New South Wales within 100 miles of Wentworth, and though the Mildura line brings the south bank of the Murray within 350 miles of Melbourne, there are no bridges to connect it with Wentworth. In fact there is a stretch of 300 miles along the Murray from Swan Hill to Murrayville which is lacking in bridges; and among the proposals of the 1920 Committee was the proposal to construct at least one bridge to give access to the Victorian railways. How-

ever, future interest in this area probably will be directed from the Victorian border rather than from New South Wales and will accordingly not be manifested until the available and more valuable land in the Outer Mallee is occupied.

Region 3 includes very varied regional facies; it contains the Outer Mallee of Victoria, the Balranald-Moulamein country which is partly mallee and partly pine-box, the Old Man Plain, and some mixed country around Mossgiel. The Roto mallee lies close to the regional border. This region has moderate reliability (index over 60 for at least one winter month) but the rains are rather low (less than 10 in. April–October). It contains a good deal of the fringe and ultra-fringe and on the ground of propinquity alone is likely to receive increasing attention. In view of the considerable degree of uniformity in the region the local character of the soil and vegetation will probably be the most important factors in future development. If we can be guided by past experience and present practice, then it appears that most of the advances will be made not in the grey-soil areas of the Old Man Plain, but in the mallee country (Outer Mallee, Balranald, Roto) or in the outlier of the Riverina facies known as the Wakool area (between Moama and Moulamein).

Much official attention has recently been given in New South Wales to the Roto mallee country. It is traversed by the Sydney to Broken Hill railway and so is 440 miles from Sydney compared with Hillston's 470 miles. It is situated in the Western Division and since under the terms of leasehold tenure which prevail in that division the cultivation of grain crop for sale is not permitted, there is no previous experience of wheat-growing. It has been estimated in an unpublished report on Mallee Investigation by E. S. Clayton of the Department of Agriculture of Sydney, that there are some 850,000 acres here which might be used as wheat country: it was proposed to open the area in conjunction with the construction of Wyangala Dam on the Upper Lachlan, part of the water from which was to be diverted to the Roto country for stock and domestic purposes. The Wyangala scheme is nearing completion, but for the time being the Roto plan has been shelved.

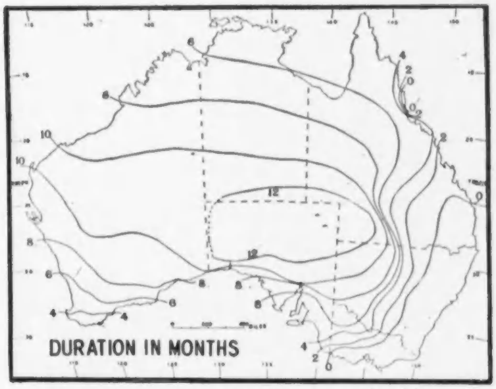

FIGURE 14.—The mean duration of arid conditions; the number of months in which the index of aridity falls below 1. The isoline of 8 months is close to, but on the arid side of, the agricultural frontier.

The general aspect of the country is similar to that around Hillston; particularly is it noticeable that there is an absence of the sandhills which are so troublesome in Victoria and South Australia, though the soils are of course as sandy as most mallee soils. The rainfall and its reliability are, however, less than at Hillston; the April–October fall is about 750 points and the October fall is 100 points. We have classed the Roto country with the Outer Mallee, but we must weigh against this the somewhat better soil quality, as shown by Clayton's analyses, and the absence of dunes. There is not much doubt that the country could grow wheat at least as well as Piangil, Annuello, and Carwarp (on the fringe of settlement in the Outer Mallee) so far as the physical environment is concerned, but we still have to

decide whether under present conditions it would be profitable cultivation. We must remember that the prospective farmer has to clear his land of the mallee, a task that takes at least three years before he can expect a crop of any worth, and that the land does not come into full productivity until ten years after clearing. In addition he can carry no sheep on his farm during the initial years and he is practically certain to experience a spell of dry years during the first ten years of the farm. To show the general magnitude of his outlay and prospective returns the following example may be taken; it must of course be remembered that the figures quoted only represent approximations and that in any specific case there would be variations due to differences in the farm quality and in the farmer's efficiency. Nevertheless they are a guide to general conditions.

The first item is the cost of the land, this varies with the quality and new Crown land is usually transferred to the farmer at a price of between 7/6 and £1 per acre; the cost also varies, of course, with the size of the farm block. It is agreed by most authorities that mallee farms on the fringe should be at least 1,250 acres; Clayton recommends 1,600 acres for the Roto area, so that the farmer may have 350 acres each in a rotation scheme of fallow-wheat-oats-pasture, with 200 acres in addition for horse-paddocks, house-yard, etc. Not many farmers using a single farm plant will sow more than 400 acres in wheat, and under conditions of efficient cultivation this is as much as is desirable. In older-established and more humid areas it is, of course, possible to obtain a reasonable living off smaller areas and in the Victorian Mallee, S. M. Wadham takes as an example a farm of 1,350 acres in which there are 400 acres each in the rotation scheme fallow-wheat-oats. If 400 acres of wheat-crop be taken as the basis for estimating returns a fairly general agreement will be reached; a figure of 1,400 acres at a price of 10/– per acre may be taken for the first cost.

The second item is the outlay required for putting the farm in commission. This will include the cost of clearing the mallee, of implements and of tractor or horse-teams, of fencing, provision of water supplies, building of house and sheds, and the maintenance of the farmer until the farm is showing an adequate return. All of these items will vary from district to district; thus cost of clearing depends largely on the size of the mallee and whether the farmer succeeds in getting a good burn-off; provision of water supply varies from the regions of artesian or sub-artesian bores to those of gravitation channel systems and those of artificial dams and iron-clad tanks; most important the maintenance of the farmer will vary according to his success in keeping down costs during the preparatory period. There will, for instance, be costs for hired labor, manures, seed wheat, and rates during this period, and the wheat gathered from the partially-cleared fields will probably not cover these. There are also the drought risks which can hardly be assessed in cash terms. The experience of settlers in the Hillston district has been that these commissioning costs on mallee land are not less than 30/– per acre; Wadham allows for the following items in the case of the Victorian Mallee farms: house and buildings, £600; fencing, £300; farmer's labor and maintenance for six years at £156 per year, £936; making a total of £1,836 for a 1,350 acre farm, or £1.7.2 per acre, to which must be added the cost of water and road supply, say 5/–; and this on the assumption that returns will cover the working costs during the preparatory period, and without allow-

ing for machinery and horses (estimated separately at £1,035). Kenyon gives figures showing that commissioning costs (apparently excluding farmer's maintenance) will be at least £2,000; on a minimum of 1,200 acres, on which his figure is based, this cost is therefore £1.13.4 per acre; Clayton gives a figure inferentially of about £3 per acre as the cost of preparing the land sufficiently to allow of satisfactory sheep-grazing; this includes the primary cost of the land. These figures agree sufficiently close to allow us to calculate £1.13.4 per acre as the minimum charge for commissioning the farm, exclusive of machinery, giving a sum in round figures of £2,330 for 1,400 acres. The outlay for machinery is difficult to estimate as it is subject to personal variation, but it is underestimated at £750 for implements and tractor or horses. Therefore the capital outlay will not be less than £3,780. The interest charge on this at 7 per cent would be £265.

The farmer has 400 acres under wheat and from this he will probably not take more than an average of ten bushels per acre on a fringe farm over a period containing both good and bad years. The average yield for Cargelligo (in a considerably better position than the Roto area) in the period 1926–30 was 6.6 bushels when one good year in five was experienced; at Condobolin (again better land than at Cargelligo) the Experimental Farm has an average of 13 bushels for a fifteen-year period, but the district average is consistently below this. For ten years before 1930 the average yield of the northern mallee of Victoria was 8.5 bushels per acre, though this was increasing at the rate of 0.28 bushels per acre per annum. Estimating the probable average yield at 10 bushels and at 12 bushels per acre will give two sets of figures and may be taken as covering the average and the good farmers. Probable returns may now be estimated and are shown in the following table where three different prices of wheat at country sidings are used:

	Total Yield	*Returns* @ 2/6	@ 3/6	@ 4/6
Yield of 10 bush. per acre	4,000 bush.	£500	£700	£900
Yield of 12 bush. per acre	4,800 "	600	840	1,080

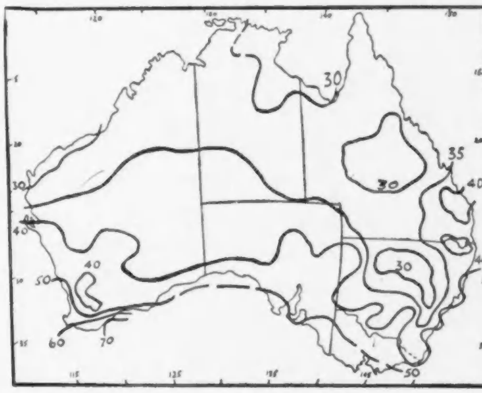

FIGURE 15.—The reliability of the annual rainfall. The higher the index, the greater is the reliability.

From these receipts must be deducted the interest charges (£265) and a charge for the working costs of the farm. This latter is extremely difficult to calculate; Wadham's figure of £578 for labor, seed, manure, rates, etc., is too low if a tractor is used. Taking, however, £500 as the charge for working expenses, the following figures result:

TABLE II

Price	2/6 per bush.		3/6 per bush.		4/6 per bush.	
Yield	10 bush./ac.	12 bush./ac.	10	12	10	12
Receipts	£500	£600	£700	£840	£900	£1,080
Interest and working costs	765	765	765	765	765	765
Income	−265	−165	−65	75	135	315

Therefore only when the price rises above 3/6 per bushel at country sidings can the good farmer expect to receive a return on his investment; should it fall

below this there seems no alternative to ever-increasing debt. It is true that no allowance is made in these figures for profit from sheep-raising; the figures themselves provide the strongest argument for the use of sheep or some other revenue-producing "second string." On the other hand no charge has been made for wheat-bags since it is possible, in New South Wales at least, that bulk-handling is available, and the costs are then somewhat lower; nevertheless, the item remains a considerable one. It has also been assumed that the farmer is an average good farmer (and all fringe farmers are not), that he does not have to invoke government assistance for working costs and provender during the preparatory period (and the South Australian committee Report shows that many do), and that, to show a profit, wheat prices return to the level of 1928 (of which there seems little likelihood). As will be seen later, farmers working under the conditions sketched above are greatly handicapped in regard to costs in comparison with those in the older wheat belt.

In most cases in these fringe districts the farmers have drawn heavily upon governmental finances, through medium of "drought relief loans," Rural Industries Boards, and like facilities; such governmental institutions advance money on much slighter security than do private financial concerns and it is notorious that many farmers are hopelessly indebted; they represent a loss to the community when they abandon their farms and their creditors' losses are written off. When they are maintained on the farm by drought relief, moratoria, government grants and similar measures the position is just as unstable. "Even if drought relief by Government loans has been effective in rehabilitating

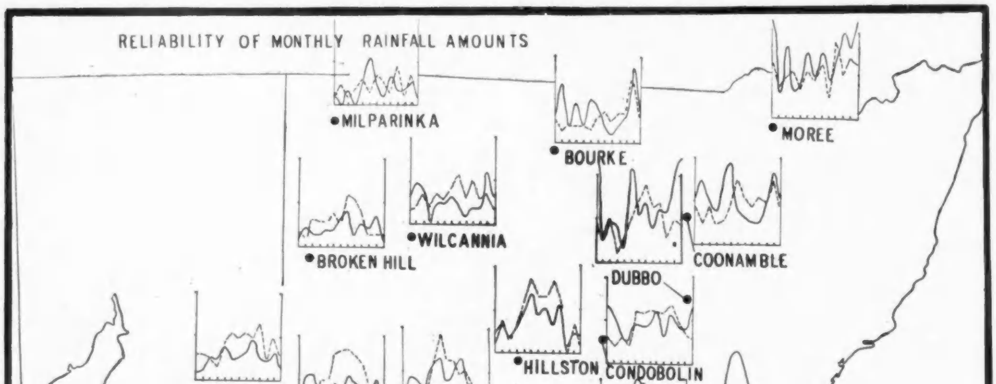

FIGURE 16.—Reliability of monthly rainfall amounts in and around the wheat belt of southeastern Australia.

distressed wheat-growers in the past, the burden to the State has now become so heavy that the time has arrived to consider future policy regarding relief. . . . If the present method of giving relief is to be continued a limitation should be placed on the amount of drought relief advanced to any one farmer in any one year, and also on the aggregate advanced. . . . There is no one specific solution to the problem of drought relief. The margin of cultivation has been extended beyond the safe limit of profitable farming [in South Australia] and it is a matter of Government policy whether farmers should be encouraged to grow wheat on lands where the variability of the rainfall is so great as to make wheat-growing precarious and uncertain." (From report of the Committee on Agriculture, South Australian Parliamentary Papers, 1931, Vol. 2.) It is becoming increasingly clear that, if these areas are to be settled, the farmer on the fringe must have a "second string" in the form of sheep, pigs, or horses, or all of these, from which some return will be obtained when the crops fail. It is also highly desirable that if these areas are to be settled under direct or implied governmental responsibility, then as a broad policy governmental assistance should be directed towards the placing of the farm in commission; that is, it should reduce the burden of the capital outlay *in the initial stages.* If, after such assistance and the passing of the developmental stage, the farmer still requires assistance, then it is questionable whether (personal efficiency or inefficiency having been eliminated) the experiment should be persevered in; farms in more favorable and better-tried areas have not been so fully developed that economic schemes are necessary to increase our national production.

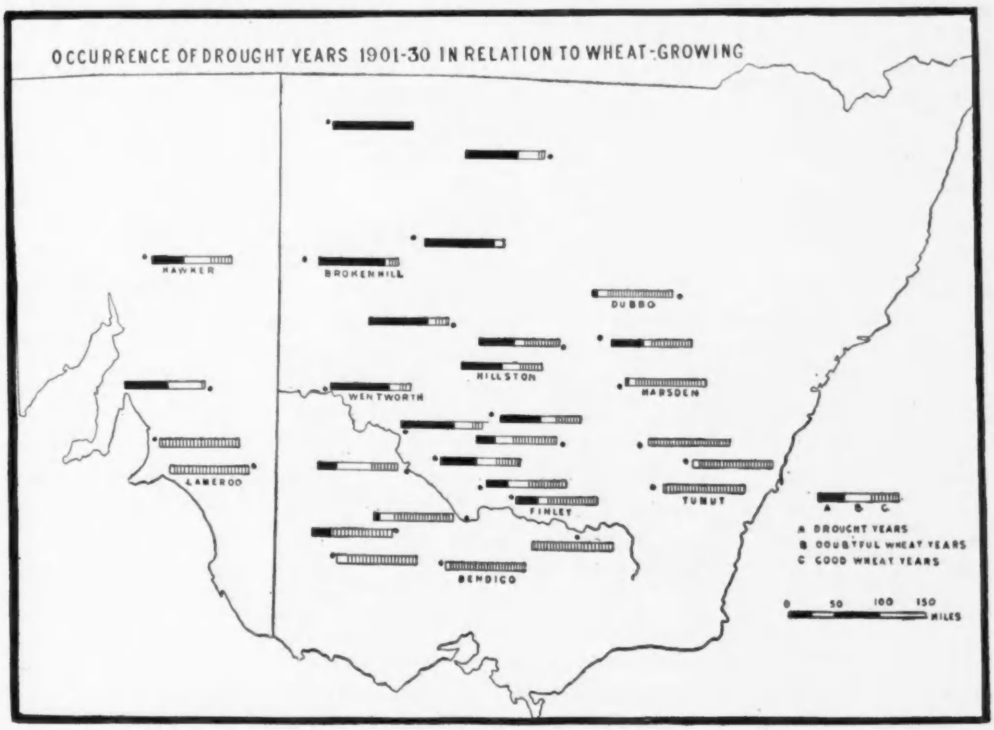

FIGURE 17.—Diagrams showing the relative frequency of good and of drought years. See text for explanation.

Farms in risky areas are bottomless pits into which taxpayers' and investors' money is thrown. The motto should be, hasten slowly and spend money on sure schemes, leave the risks to the future. Above all it must be realized that if it is impossible to maintain the present fringe farms in a reasonable economic position, then plans of extension are absurd.

Much of what has just been said apropos the Roto mallee applies also to the Outer Mallee. But here there has been no artificial barrier such as the boundary of the Western Division, and as a result there is a fair mass of experience accumulated about the wheat-growing capacities of the country and settlers have been more or less free to experiment for themselves. Along each of the northward-running lines there is a creeping tide of settlement which fluctuates with economic and climatic conditions, but which continues to move towards the Murray. It has gone past Annuello to Robinvale, past Carwarp to Red Cliffs, past Red Cliffs to Meringur. We have already seen the judgment of a competent committee on the South Australian fringe, and their opinion has been borne out by a certain movement of retreat from the Pyap and Loxton areas. In Victoria the farms have come close to similar conditions climatically, and Professor Wadham sums up that "with wheat at 3/6 on country stations the enterprise of opening new fringe mallee farms is not worthy of consideration, whereas even at 4/6 per bushel it is not better than a 'marginal proposition!' " The further one passes beyond the present fringe, the more serious are the problems of drift and salt, and clearing costs are certainly not less.

It appears that here again the limit has been reached, but another point must be emphasized. In all the fringe areas we find considerable differences in farming skill; the really good farmer can usually make his crop pay even when many other farmers of the district are reporting failure. The difficulty has several sides; many of the new farmers are inexperienced in fringe conditions, many are inherently poor farmers, many have not the resources in money or implements to put their knowledge into practice. In the past it has been too easy for the inefficient to obtain holdings under selection or by ballots or by other schemes; the agricultural graduate is scarce and is rarely given preference. On the other hand there is much to be learned even by the experts in cultivation methods on the fringe; we may expect the future to show a marked improvement in this direction through the cooperation of farmer and agricultural instructor. In the meantime we find that, given reasonable chances, the farmer himself can very largely make or mar his own fortune; the good man is willing and able to learn, to experiment, and to profit by his experience.

Region 4 is the main wheat belt of today. It has reliable winter rains with reliability indices of more than 60 for the winter months, totals during the growing period of between 10 and 20 inches, and October falls of over 175 points. It comprises the Inner Mallee and Wimmera, the Riverina, and the Hillston-Wyalong Mallee. Settlement may be taken as definitely established in most parts, though the newer areas (e.g., Hillston, Rankin's Springs) may see several adjustments; while a good proportion of the available and arable land is taken up. The opportunities here lie in the direction of increased productivity by means of increased yields, by heavier and more widespread sheep-raising on the farms, and by the provision of water-supplies to increase the stock capacity. As regards the first of these, the increased yields, we may quote again from

the report of the South Australian Parliamentary Committee a remark which may be applied to all the settled wheat areas of eastern Australia: "as a result of clearing up partially cleared lands, and by the adoption of up-to-date methods throughout the wheat-growing districts, higher yields per acre may be expected. Without opening up more land, an average wheat crop of 60,000,000 bushels for South Australia should be attained in the near future." This figure means the doubling of the present yield in South Australia alone and the Committee recommends that no more "scrub" land (mallee) be opened up until this unused and partly-used land in the present zones of settlement be fully developed. The lesson taught by the Wimmera farmers who have raised their yields by at least ten bushels in the last two decades may be assimilated by the mallee farmers and applied to their different conditions.

In the second particular, sheep-raising is important through most of the farms of the older belt, and sheep are also to be found on many farms in the mallee areas. Nevertheless the numbers of sheep carried could be increased with great benefit to the farmer and to the farm; this is one of the precepts constantly being taught by the agricultural instructors in the several states. In most of the Victorian Mallee the carrying of sheep is dependent upon the provision of water-supplies, and this has been done by the Victorian Rivers and Water Supply Commission by means of the gravitation system. New South Wales, though slower to move than Victoria, is coming into line by planning schemes along the Lachlan and Murray. The Wakool area (region 3 above) is to be supplied with water from the Hume Dam on the Murray, and the Finley-Berrigan country will probably also be assisted in the same way. This water is not intended for plant irrigation, but purely for stock, and is therefore a step in the diversification of farming by increasing the stock capacity.

It has been said above that experience has shown that in most parts of this region the farmer will find the physical conditions favorable to successful cultivation; and that cases of financial distress are usually due to inefficiency or inflated land values. The 1934 Commission has presented some pertinent information which was not hitherto available and which has been obtained by means of questionnaires submitted to a group of representative farmers. In the first place, it offers a table showing the variation in costs per bushel through the farming population; these costs being taken to include the working expenses of the farm plus a sum (£125) as a minimum for remuneration to the farmer for his labor; the table is as follows:

TABLE III

3.9	per cent of the farmers are producing for less than	1/–
27.0	" " " " "	between 1/ and 1/11
38.9	" " " " "	" 2/ " 2/11
18.6	" " " " "	" 3/ " 3/11
6.6	" " " " "	" 4/ " 4/11
4.9	" " " " "	at 5/– and over.

When the interest charges on borrowed capital (not on the farmer's own investment) is considered, it is found that the following relations hold:

TABLE IV

21.5	per cent of the farmers have an interest charge of	3d or less
25.9	" " " " " "	4d to 6d
14.6	" " " " " "	7d to 9d
14.4	" " " " " "	10d to 1/–
9.5	" " " " " "	1/1 to 1/3
5.5	" " " " " "	1/4 to 1/6
2.8	" " " " " "	1/7 to 1/9
6.6	" " " " " "	1/10 & over

Rept. Roy. Comm., 1934, p. 26.

In the report of the Royal Commission for 1934 these statements are made: "Approximately 30 per cent of the wheat producers are confronted with interest charges of 1/– per bushel or over." As regards working costs and interest charges: "A price of 3/– per bushel would enable about half the wheat farm-

ers of Australia to meet their expenses and commitments under present conditions of costs and interest. It also appears that three-quarters of the producers would be able to continue without adjustment when the price is 3/10½ per bushel at sidings. That number would not be drawn proportionately from the various States. There would be a higher proportion from New South Wales and Western Australia, and a somewhat lower proportion from Victoria and South Australia." Also: "The Commission is aware of the fact that for various reasons wheat-growing

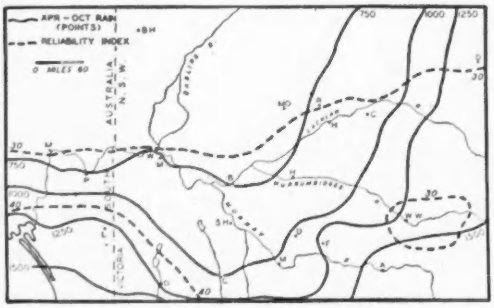

FIGURE 18.—The reliability of the April–October (wheat growing season) rainfall. Note the correspondence of the 750 points isohyet with the agricultural frontier shown in Figure 2.

has probably been pushed into certain less reliable districts where costs are inevitably high. It is also known that some farmers have small acreages which force them into inefficient practices and that others lack the capacity to manage farms; consequently no plan can be expected to provide conditions which will rehabilitate every wheat-grower in the industry."

The fact that costs are relatively high in the areas of new settlement does not mean that the debt-burden is also higher, for it is in the older-settled and more reliable areas that loans and mortgages were more easily negotiated in the boom years. Working costs as a rule are low; the debts oppressing most farmers are due to inflated land values and extravagant expenditure during the boom years followed by a period of unfavorable seasons and declining prices. The following paragraph expresses succinctly the problem facing debt-burdened farmers: "The fall in wheat prices, notwithstanding the reductions in interest and other costs, has occasioned an enormous increase in the burden of the debt expressed in terms of wheat. For instance—a debt of £1,000 represented 4,499 bushels of wheat when the price was 4/6 per bushel on the farm. When the price had fallen to 2/– per bushel the same debt represented 10,000 bushels. If 7 per cent be taken as the rate of interest before the depression, 310 bushels at 4/6 paid the interest bill of £70. With a ruling rate of interest of 5 per cent and wheat at 2/– the number of bushels required to pay the interest bill of £50 is 500, an increase of 60 per cent. If, however, the excess of the selling price over working expenses (No. 1 costs) is considered, the increase in the interest burden is larger still. For example, if No. 1 costs were 3/– when wheat was 4/6 the margin was 1/6 per bushel—930 bushels would provide sufficient surplus to pay the interest bill of £70. With wheat at 2/6, however, and No. 1 costs reduced to 2/–, the margin is only 6d per bushel, and to pay the interest bill of £50, 2,000 bushels are required, an increase of more than 100 per cent."

Region 5 is a portion of the wetter and more rugged slopes on the eastern margin of the wheat belt. The rainfall is over 20 inches during the growing period and is approaching the humid limit for wheat-growing; the broken topography also hinders extensive cultivation and there is evidence that the area under wheat is decreasing in favor of more lucrative and intensive types of land use.

It is now possible to summarize in

general terms the position of the wheat industry from the point of view of productive capacity. It is obvious that most of the country discussed, except that labelled Region 1, is climatically capable of producing wheat in years of favorable rain conditions. It is equally obvious that the frequency of such favorable years varies considerably over the area and that on the present farming fringe it is sufficiently low to make insecure the economic position of the average farmer at present price levels. In the safer districts also the low price levels have developed a serious financial position, so that the forces behind the decline in prices become vitally important for the future of the wheat industry.

The Market Problem

The economic problems facing the wheat industry are international in scope; mounting costs of production, increased production in all countries both exporting and those which were formerly importing, decline in world price levels, and an increased world surplus or carry-over. With the restoration of the wartime-deserted wheatfields of Europe there has been less demand for the surplus wheat of the exporting countries, and with the removal of this stimulus, which had led in all those exporting countries to increased acreage and production in wartime and post-war years, it was inevitable that the world should enter upon a period of low wheat prices. The average Australian pre-war production was 90 million bushels; during the war it rose at one stage to over 150 million bushels; in 1928–9 160 million bushels were produced; and, with the advent of the economic depression in 1930 and the consequent desire to increase returns, the record production of 213 million bushels was reached and the total has remained above 175 million bushels since. On the other hand prices are steadily falling. (See T. R. Smith, "The Wheat Surplus," *Geographical Review*, Jan. 1935, p. 107.) Pre-war price f.o.r. Australian shipping ports in 1913 was 3/7 per bushel; in 1920 it was over 8/6; in 1924, 6/6; and in 1932 it had dropped to 2/10. We have therefore expanding production with contracting returns.

It was of course precisely during the period of high prices that most of the areal expansion of the industry occurred. From 8 million acres in 1918 the area under wheat increased to 16 million acres in 1932, and the greater part of the new ground broken was in the fringe areas. Now, it has already been shown that it is precisely in these areas that one expects to find heavier initial costs: the farmer may find himself hopelessly overcapitalized or indebted before his farm has reached normal producing capacity. Cases are common in which the initial outlay plus subsequent relief in the form of governmental grants and private loans reach a figure in excess of the present-day value of the farm. Much of the assistance has come from official sources and the governments are now the chief creditors of the fringe farmers, though private interests, such as private banks, trustee companies, assurance companies, and individuals have contributed largely. It has been estimated tentatively by the 1934 Royal

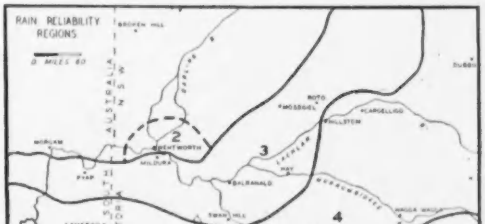

Figure 19.—Regional divisions on the basis of growing season rainfall and its reliability.

Commission that the wheat-growers' debts total somewhere in the vicinity of £140 million, of which the share of the governments and of the state banks is rather more than a third. These figures apply of course to the whole of the Australian wheat belt and are spread over some 70,000 wheat-growers, but they convey the magnitude of the indebtedness.

Only voluntary or enforced forbearance on the part of creditors has prevented wholesale abandonment of heavily-indebted farms, so that the situation that faced the Commonwealth at

FIGURE 20.—Sowing on a mallee field that had been "rolled" the previous year. Note the mallee "shields" and the suckers. Near Hillston, New South Wales.

the height of the depression was one that involved seriously not only the farmers but also the interests of the governments themselves and of a large body of private investors. The remedial steps have taken the form of moratoria and the adjustment of principal and interest on Crown debts on the part of the State Governments, while the Commonwealth Government has between 1932 and 1934 provided some £8.5 million as grants for wheat-farmers. The scheme now proposed by the 1934 Royal Commission provides for the distribution of another £4 million and for continuing relief from the proceeds of the flour excise tax.

On a broad survey of the problem two possible policies suggest themselves. The first is a continuance of governmental paternalism in the form of grants and establishment of artificial market conditions as in a home-consumption price. The grants may take the form of direct money payments (as in the case of the £4 million), of reduction of taxes, scaling-down of interest rates, increase in the exchange rates; all of these and similar suggestions involve the sacrifice of governmental revenue in favor of the wheat-farmer. This policy implies a belief that the assistance provided will maintain the great majority of farmers on their holdings without serious increases in their present indebtedness and that world grain trade conditions will improve significantly in the near future. The fallacies in this position lie mainly in the assumption that the present surpluses in the world's markets and the low price level are due primarily to decreased purchasing capacity of the hitherto importing countries; it is probably more correct, in view of the decline of wheat prices and the building up of wheat surpluses that were already in evidence before the onset of the depression, that there is now genuine overproduction in relation to the consuming capacity of these countries. In that case much of the post-war expansion of wheat acreage in the exporting countries would be normally unjustified by the size of the world demand. It must be remembered that trade restrictions in the European countries have had much to do with the surpluses of the exporting countries and that their removal would stimulate trade considerably. On the other hand this would result in a restriction of acreage in these European countries; the argument of world overproduction on the present acreage is not affected thereby. Moreover it is not possible to forecast any such European action. Australian export to the east has increased considerably during the

depression, but this is mainly due to the prevailing low price; if the world price rose to the level at which the Australian farmer would be showing a profit on his present investment, this eastern market would almost certainly revert to its former unimportance. Amelioration, therefore, must wait on removal of trade restrictions or on increased purchasing power in countries now dependent on cheaper but deficient foods; both of these eventualities appear remote and there is no immediate hope of a return to those post-war prices at which alone, under present conditions of costs, can the fringe farmer, at least, be profitably occupied.

The other policy involves a reorganization of the industry so as to retain the efficient units and eliminate those which are hopeless or in which the risks are excessive; the efficient being those who can continue production under present conditions with any possible assistance in the lowering of costs which can be rendered by governments without much sacrifice of their own revenue, and which can be arranged by cooperation between investors' and farmers' organizations and labor organizations. The remainder would be transferred to other rural activities or absorbed into other industrial branches. The output would be reduced to a figure more nearly corresponding with world demand and reorganization on the basis of present world conditions would leave the industry in a strong position to take advantage of any improvement; government funds would be left free for the stimulation of other industries along lines that are more likely to lead to a general national revival. On the other hand it would be a costly process, for it would entail a scaling down of capital values of those farms which would be diverted to less intensive forms of occupation and so a direct loss to some section or sections of the community; at least part of this loss has, however, been in reality incurred already with the deflation of values since the onset of the low-price period. A further objection is that it is doubtful if modern social organization is sufficiently flexible to allow of the surplus farmers being easily and readily absorbed into other productive channels. Nevertheless the decision must sooner or later be made if the situation is to be rationally controlled, and the community seems faced with a loss in either direction; the subsidy in one form or another of unprofitable farming in the hope of radical changes in world economy, or the writing-off of riskily-invested capital with a view to avoiding further unproductive expenditure—this is the choice which seems to face governments in all the chief wheat-exporting countries.

THE OLIVE INDUSTRY OF SPAIN

William E. Bull

IF SOME malignant little sprite should wave a fairy wand over the face of the earth and cause all the olive trees thereon, except those in Spain, to blight and fade away, in 20 years Spain could meet the world demand for olive oil; in 5, she would be able to supply the total market in non-producing countries.

Spain, today, is the largest producer and exporter of olives and olive oil in the world. Since 1917–18 she produced, on the average, over one-half of the world's supply of olive oil, and in 1927–28 and 1929–30 she exceeded, by nearly a million quintals, not only the usual average but the total production of the rest of the world for those years. For the last ten years the provinces of Jaén and Cordova, alone, normally have produced more annually than the Italian average for the same period.

Spain has over 52 per cent (2,062,000) of the olive acreage and 67 per cent of the producing trees in the world. Olive acreage ranks second only to cereals in Spain, taking 13 per cent of the land in productive crops in 1933. In agricultural income the olives do not rank so high. In 1932–33, of the total agricultural income 44 per cent came from cereals, 10 from tubers, bulbs, etc., 8 from fruits, 7 from grapes, and 5 from olives. The ratio was about the same in 1931. In 1930 the olive traded places with legumes and came in sixth. This was an "alternating" year when the trees were recuperating from the burst of production which brought the olive into third place in 1929. On the average the olive stands a strong fifth in agricultural income with 6 to 7 hundred million pesetas a year.

Development of the Olive Industry in Spain

The olive appeared in Spain some time previous to the last glacial epoch, probably contemporaneously with the appearance of man. Fossilized olive pits have been found in Tertiary formations in many parts of southwestern Europe. Whether these varieties, some of which were the ancestors of those now domesticated, survived down through the ages in Spain is a debatable question. There were wild olives in Spain when the Phoenicians arrived (1100 B.C.), but it is not known whether the varieties now domesticated there already existed or were imported by the Phoenicians. They did, however, sell oil to the Iberians, a fact which indicates that if the tree was already domesticated there it was not well developed nor abundant.

After the Roman occupation of the Peninsula (206 B.C.) the olive industry began to assume a definite identity. The Romans encouraged the planting of orchards to provide food for the Empire. The areas cultivated were practically the same as today, the Andalusian Lowland being most important. With the downfall of the Roman power and the incursion of the Goths (409 A.D.), the olive industry fell off and did not again revive until after the invasion of the Arabs (711 A.D.). They brought it to a high level, building fine irrigation systems and laying out excellent orchards.

During the active period of the wars of Christian reconquest (14th and 15th centuries) the industry again lapsed into a decline, although it remained compara-

tively active until Philip III expelled the Moriscos in 1609. Without laborers the industry slumped considerably; many orchards were completely abandoned. It did not begin to recuperate from this disaster until the eighteenth century when Charles III brought in German peasants to repopulate the deserted villages. But before the industry could reestablish itself it was cut short by the War of Independence (1808–14). This war, the revolt of the American Colonies (1820), and the Carlist Wars (1833–55) again reduced the population to a very low figure. Consequently, the labor supply was not sufficient, and, once more, the olive industry was set back.

In 1884 Spain exported a little more oil than she imported, and, four years later, the government, seeing the prospects of revenue, set about to stimulate the industry. Schools of olive culture were created, and an attempt was made to study the influence of climate, terrain, variety, cultivation, and methods of processing upon the quantity and quality of oils. Nevertheless, improvement was not scheduled to arrive post haste. In general the orchards continued to be poorly tended, many being allowed to grow comparatively wild and untouched except at harvest time. Harvesting and extraction methods were crude and unscientific, and the olives and oil obtained were, for the most part, of very inferior qualities. The greater part of the oil was consumed domestically, although exportation reached an average of about 17 million kilos per year for the last decade of the century. Most of this was used as fuel oil by Italy and France.

The loss of Cuba and the Philippines in the Spanish-American War, and the subsequent depreciation of the peseta did much to set the Spanish olive industry on the road to world-wide importance. With the last important colonial possessions gone forever, the government could concentrate upon domestic problems; with the aid of a depreciated currency Spanish olive oil began to encroach upon other oil markets.

Although production declined for the first years of the century, by 1907–08 improved methods and increased acreage (Figure 3) began to show an effect upon the annual yield (Figure 4). In the next few years the government pro-

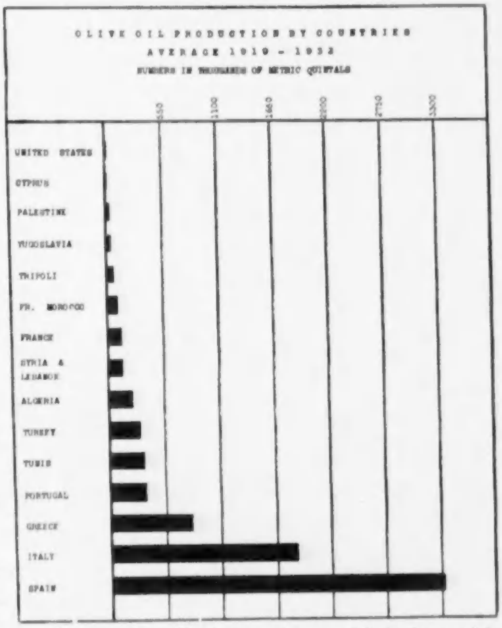

FIGURE 1.—If she could establish favorable trade agreements, Spain's great production would put her in a position to control the world market. Since 1927 Portugal has outstripped Tunis; Tunis has produced twice as much as Turkey, which has traded places with Algeria.

claimed some 25 laws regulating manufacturing, refining, shipping, and adulterating of oils. More and finer grades soon appeared on the market and exportation doubled over that of the last years of the nineteenth century to an annual average of 37 million kilos. By 1914 Spain had become the greatest olive oil exporter in the world. Though general progress was characteristic of the entire industry, production methods still lagged far below the ideal standard.

The generally increased activity due

to the World War had considerable influence. Prices increased steadily, in keeping with the rapidly growing demand; domestic consumption became greater and qualities improved. The trees were cared for better, new orchards continued to be set out, and the young trees planted at the beginning of the century came into bearing. Exportation of oil reached an average of 78 million kilos a year. The increased business, general prosperity, and the need for more pure oil brought about the appearance of the first oil refineries in Spain.

Most of the period of 1920–34 was marked by intense activity in the entire industry. Acreage continued to increase until 1932, and Spain attained the distinction of producing, on the average, over half of the world's supply of oil. However, toward the end of this period exportation of oil fell far below the average for 1914–1919. The increased number of refineries has influenced the qualities of oils; less work has been done to perfect the natural production of finer oils as they cannot compete in price with refined oils.

FIGURE 2.—Majorca, Balearian Isles. A typical gnarled and hardy olive tree which has outlived a millennium. Trees of this age are not uncommon in many parts of Spain. (Courtesy *Ministerio de Industria y Comercio, Oficina del Aceite*, Madrid.)

In 1924 the first "Oil Conference" was held in Madrid and from it was born the Federation of Olive Oil Exporters of Spain, an organization attempting to unify exportation systems, resolve export difficulties, and discover and enlarge foreign markets. In 1925 the National Association of Olive Growers was created. Its object is the protection of the olive industry in all its technical, economic, and commercial aspects. The Association sponsors meetings for the discussion of better cultivation, and laboratories for experimentation. It publishes informational magazines for its members and attempts actively to influence the government in the legislation of favorable laws. In February, 1932, under the Ministry of Agriculture, Industry, and Commerce, the Office of Olive Oil Propaganda was organized as an adjunct to the Mixed Oil Commission. Its purpose is to spread knowledge of Spanish olive oil in all the world markets. The government has gone even farther in laying a solid foundation for the olive trade, especially in the export division. It has reduced the import of non-drying oils, forbidden the blending of oil extracted from olive pomace with pure oils, and has tightened up on sanitary restrictions.

NATURAL ENVIRONMENT

Few trees respond as readily to climatic and soil conditions as the olive. For example, the *gordal sevillana*, a green-pickling olive much exported to this country, can be successfully grown, as the Arabs put it, only as far as one can see from the top of the *Giralda* in Seville. With variations of a few miles in either

direction this is practically true; nearly all of Spain's green-olive pickling industry is concentrated in an area not much greater than a long day's walk from Seville. In widely different climatic zones the variation is still more distinct. Along the Andalusian littoral the intense heat tends to produce fatty, high-colored, and rather unpalatable oil used mostly for industrial purposes, while the finest oils come from Tortosa on the more temperate Catalonian coast.

Figure 5 shows practically all the important olive regions of the world. Warm temperatures, absence of severe frost, low humidity, and favorable winds are the four fundamental climatic conditions required for olive culture. The closer the variety is akin to the wild olive, the *acebuche*, the better it can resist low temperatures. The hardier ones can endure temperatures of 14 to 10° F., the more domesticated ones 20 to 18°. The tree can resist a prolonged but moderate cold spell much better than a short, severe period followed by a rapid thaw.

The olive is intolerant of excessive humidity. Heavy rains hinder the development of flowers and continued dampness usually results in diseases. Being a low tree, with a thick, corky bark, small thick leaves, and a very elaborate root system, it is better prepared to withstand comparative dryness. Drought does not permanently injure it as a rule, though excessive heat and lack of rainfall will (as in 1934) cut down the production.

The tree is equally sensitive to winds: too strong winds "fatigue" it, as the growers put it, retard its growth, cause it to become distorted (Figure 2), and if predominantly from one direction stunt that side. On the other hand, successful cultivation requires a steady movement of temperate air to prevent air stagnation which is conducive to the growth of pests and parasites.

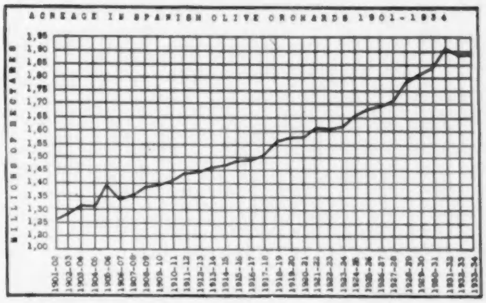

FIGURE 3.—The increase in acreage continued until the present depression and modern tariff walls caused prices to decline too low to encourage further planting. The decline since 1932 is due to old trees being cut down without being replaced and to growers rooting up entire orchards in order to put the land in more profitable crops. The peak of 1905–06 is probably due to faulty statistics. (NOTE.—These figures indicate only orchards in active production.)

In summary, the climatic requirements are: a fairly mild winter with sufficient precipitation to carry the tree through the dry summer months but not enough to water-log the soil; a warm, early spring with warm rains, and between 3,400 and 3,900 heat units for the period beginning with the time of flowering and ending with the harvest or the first frost.

In a land of fire and ice, rain and aridity, such as Spain, regional climatic differences are necessarily sharp; consequently it is impossible to define large areas which are entirely adapted to the olive. Severe frosts make it impossible to maintain the tree on the upper slopes of all the mountains and in nearly all of the northwestern provinces. In the extreme northwest excessive rainfall rules it out. It has proved uneconomical to keep up many of the groves in Galicia, the Basque Provinces, much of New Castile, and Catalonia. In fact, most of the orchards which approach the northern climatic limit (Figure 5) are comparatively unhealthy and unproductive.

The north Mediterranean coast and the Andalusian Lowland, especially in the basin of the Guadalquivir, are the areas most adapted to the olive (Fig-

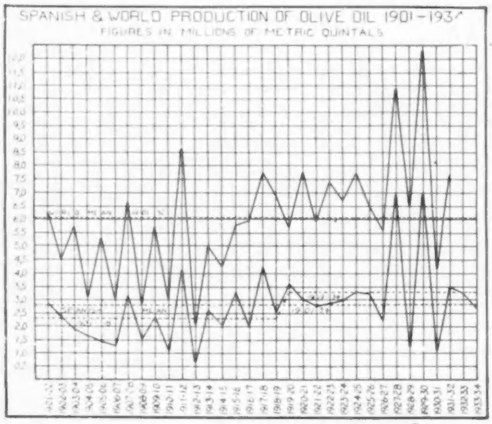

FIGURE 4.—The sawtooth nature of the lines is due to "alternating" years; the higher the rise one year the lower the slump the next. Science is unable to completely cope with this problem; after a year of heavy production the tree must recuperate. Notice that since 1915 the average Spanish production comes, generally, above half of the world production.

ure 6). The yearly temperature average is high enough to produce the required number of heat units; frost, though frequent, is not generally severe along the northern Mediterranean coast and is not to be feared to any extent in Andalusia except in those sections of Granada, Malaga, and Jaén where the olive is grown at rather high altitudes.

Almost all of the most productive regions come in sections where the precipitation is under twenty inches, with less than two inches during the three summer months (Figures 7 and 8). Although the summer drought does not generally harm the tree, greater production results from irrigation in the drier sections.

Within the same locality, variations in slope and the direction it faces and altitude may have a marked influence on the maturing period, quantity of oil, and the health of the tree. The tree is less subject to disease, harm from frost, etc., if it is on a gentle slope where both soil and air drainage are good. However, in actual application the olive grower does not seem to heed these principles, for no reasoned choice of topographic location, terrain, or soil is generally made. Certain regions have been found by centuries of experimentation to produce fair or excellent olives and the land in that section, regardless of situation, is planted in them. The orchards run up and down every hill and mountain side, the tree frequently clinging to slopes so precipitous as to make it almost impossible to pick the fruit. This does not mean, however, that the trees in the more favorable situations do not produce more abundantly.

The correlation between soil and quality of oil or type of fruit is not as evident as that of soil and quantity of oil, size of fruit, stature and health of the tree. The quality of the oil depends largely upon the methods of extraction, first-class virgin oil having practically the same qualities from all sections in a given locality, regardless of soil. Unfortunately for many Spanish growers, the place for tree-crops in their system of land utilization has been based, probably unknowingly, on the formulations of Theophrastus (313 B.C.), as typified in the following lines from Virgil's Georgics:

> And first for heath and barren hilly ground,
> Where meagre clay and flinty stones abound;
> Where the poor soil all succor seems to want,
> Yet this suffices the Pallidian plant.

In every region orchards will be found in poor, arid soil which the grower has considered useless for other plants. Such orchards are usually poorly developed and diseased, yielding poor and small quantities of fruit. Of late the orchardists have considered this factor and have been more careful in the selection of soil and position, but in an industry with trees as long-lived as the olive the poor judgment of their ancestors will be inflicted on several generations yet to come.

Due to variations in methods of culti-

vation, amount of fertilization, age and varieties of the trees, it is impossible to make a comparison of production between provinces having poor soil with those of good soil. However, it is significant that the olives of the Andalusian Lowland, the center of intensest production, are grown in alluvial soils, sandy clays, and calcareous marls, all high in lime and rich in organic matter, and that, on the whole, the production is higher per acre than in Central Spain where the olive is grown on badly leached, thin, calcareous and clayey earths, known as *almendrilla*. Along the Mediterranean coast from Alicante north the olive is generally grown in red or light-colored chestnut earths which were developed under grass and are fairly rich in humus.

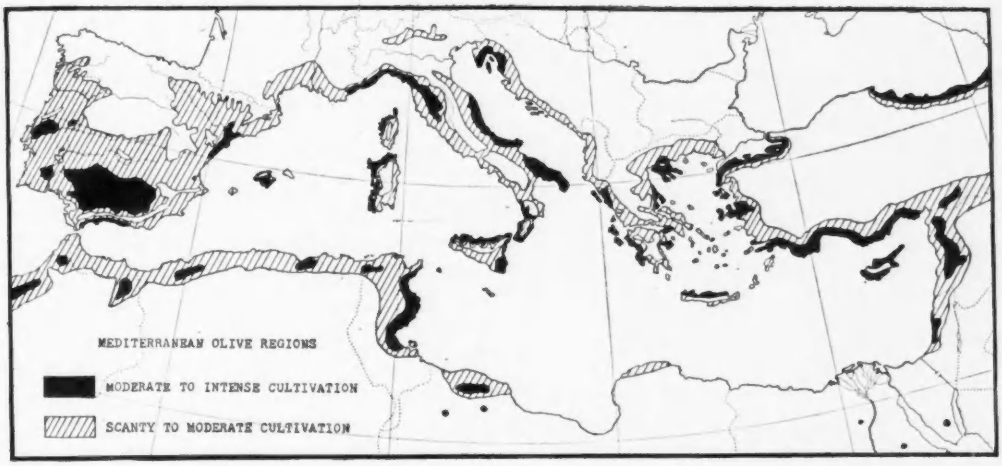

FIGURE 5.—The regions shown on this map produce 99 per cent of the world olive crop, the majority of it coming from the European countries.

METHODS OF PRODUCTION

The wild olive (*acebuche*) is a small evergreen, bush-like tree with thorny branches and a small and comparatively hard, thin-fleshed fruit. This tree is abundant and exists in practically all of the provinces of Spain. It is of no great commercial value except for its wood and as hog feed. The cultivated tree, although having the same general characteristics, is significantly different. It grows from twenty to thirty feet high, with spreading, finely divided, angular branches which form a symmetrical head. The fruit is usually larger than the *acebuche's*, the pericarp not so hard and much thicker. In contrast to that of the *acebuche* it contains a great quantity of oil.

About 27 varieties of the olive are found in Spain. Each one has its own peculiar requirements in regard to soil, position, etc., though the pickling olives are usually more exacting. These have a large fruit and a comparatively small amount of oil. The *gordal sevillana*, the king of the pickling olives, has the largest fruit of any. It is a good-sized tree, very productive, but requiring excellent soils, much cultivation, considerable fertilization, and careful pruning. It is at its best around Seville. The *real* and *manzanilla* are the two next important pickling olives. Both have a large fruit and enough oil so that they are often grown for it. They are found in almost all the olive provinces.

The greatest variations are found among the oil trees. The *picudo* is a

large and vigorous tree which grows very tall in good soil, being one of the finest looking Spanish olive trees. It is very productive, but requires rich, friable soils. The *verdial* is a smaller tree, more rustic, but consequently better adapted to poorer soils, colder, and drier regions. The *verdial* is more common in the north, the *picudo* in the central and Mediterranean regions. The *lechín* and *cornezuelo* are the hardiest of their kind. The *lechín* is quite rustic, with a small fruit, but it produces abundantly and ripens early. Because of heavy production it quickly exhausts the soil. The *cornezuelo*, in contrast, is a large tree, with a medium-sized fruit, rich in good quality oil. It grows in most any soil and in cool localities. Both trees are most common in the south.

The growers' associations and the government are making tests to determine the best locations, soils, etc. for the more important varieties, and in the future the different varieties will no doubt be more definitely localized with respect to these factors.

There are many ways by which the olive may be propagated. The seed, being the natural way, is the best, but as practically all trees grown from it revert to the wild stage the grower must graft the desired variety upon the seedling. Although there is now a tendency to use this method more often, it was formerly little used. At present, it is most general in the green pickling regions.

The two most common methods of reproduction are by *estacas* (cuttings) and *garrotes* (truncheons). The *estacas* are 5 to 6 year old suckers which are planted in nurseries and allowed to grow to 8 to 10 feet before they are transplanted to the field. The *garrotes* are shoots recovered from the annual prunings which are usually planted directly in the field. Trees grown from *estacas* begin to bear three or four years after transplanting. The *garrotes* are cheaper and more rapid as they grow to bearing trees in 6 to 8 years. However, the extra expense of raising the *estacas* is often repaid by healthier and sturdier trees.

Few of the trees, except certain dwarf varieties, grown by any method reach their full producing power until 20 to 40 years old. In general a tree in good soil, under favorable climatic conditions, with careful cultivation, will live to be 300 years old. There are numbers of trees which continue to live to twice this age and some that reach the hoary age of 1000 years (Figure 2).

In the early days of olive culture no particular method of planting was followed. As many trees as were convenient were planted per hectare, without much thought for planning systematic orchards. Since the industry has come to be of great commercial importance definite systems have developed. Two are now generally followed: the *marco real* formation, with trees planted equal distances apart, forming a square; the *tresbolillo* (quincunx) in which three trees form an equilateral triangle which is repeated throughout the field. The *marco real* was formerly preferred. The *tresbolillo* is by far the best system: there is a greater distance between the trees, they are better distributed, cultivation can be done three ways instead of two, and more trees can be planted per acre. The general maxim followed in Spain is to plant the trees about twice as far apart as they grow high. Plentiful sunlight and good ventilation are necessary for healthy trees. The average number per hectare is 100. On the whole this is too dense to allow associated crops. Where they are grown, the number of trees per hectare diminishes proportionately.

Cultivation is exceedingly important if abundant harvests are desired.

Though in some regions it is carried on as scientifically as in any agricultural industry in Spain, in general, it is not very well done. The usual method is as follows: for the first 8 to 10 years after planting an orchard the ground is plowed three times a year, about ten inches deep. The soil around the tree is hoed three times annually for the first two years, and after that twice a year. Generally, from then on, besides hoeing, no other cultivation is practised. To further the development of more scientific methods the government has established experimental stations in Jaén and Baeja (Jaén), Lucena (Cordova), Almodovar del Campo (Ciudad Real), and Tortosa (Tarragona).

Artificial fertilization is one of the big factors in the elimination of years of low production. This alternation (Figure 5) is largely due to inadequate nutrition. The fruit appears on two-year-old branches which having once produced do not do so again. If the tree cannot obtain sufficient food to recuperate rapidly enough to grow a new set of branches for the following year, the crop will be small. As practically every other year is a "low" one for Spain, it follows that the number of *veceros*, or alternating trees, is large, and that fertilization is not generally practised. The cost is too high except for the larger growers and not entirely profitable under present conditions except in the relatively valuable green olive lands. Ordinary farm manure, the ashes of the branches cut off by pruning, the refuse left after the oil is extracted, the water obtained from the fruit in the same process, and chemicals make up the list

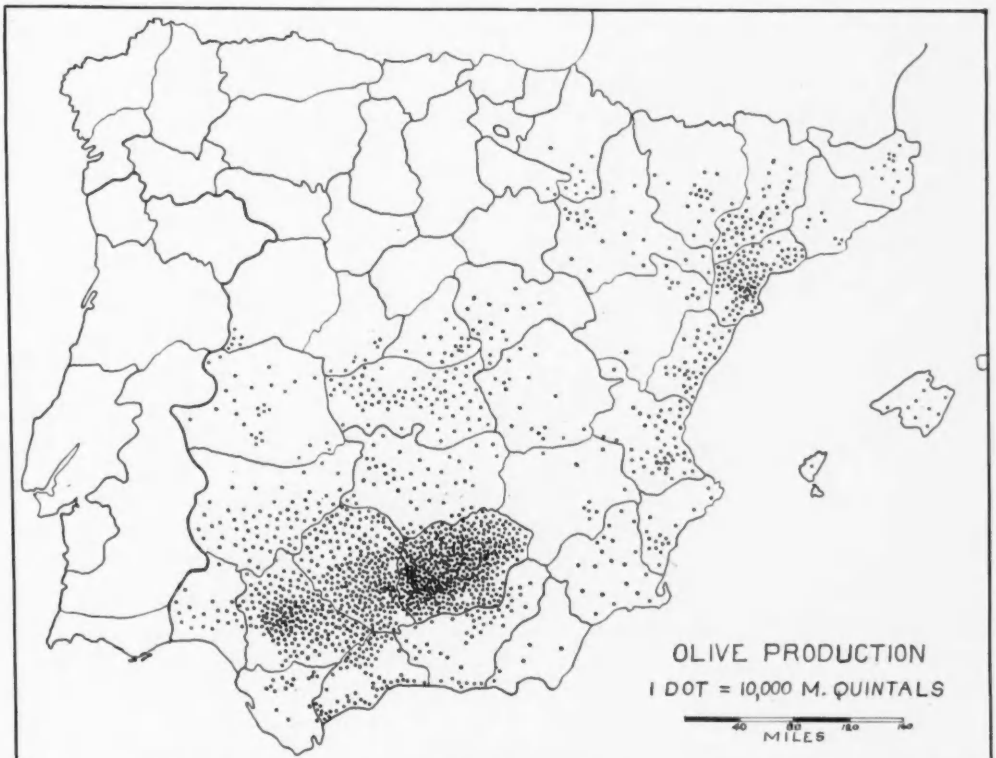

FIGURE 6.—Regions of olive production in Spain. The olive exists in regions not shown on this map, as a comparison with Figure 5 will show.

of fertilizers used. It is generally stated that fertilization will increase the crop by 25 per cent, but this is hard to demonstrate and, while the market remains flooded, not worth doing. Consequently, many growers remain content to use merely what manure and production refuse they have.

Irrigation in most regions of Spain has not been well developed. The youthful stage of most of its river valley systems has made the establishment of irrigation systems extremely expensive, and the porosity of the bed rock, especially in the south, has foredoomed several costly experiments. The Republic is contemplating a large development along this line, but funds are lacking at present to carry it out. The actual acreage of olives in irrigation has recently decreased until there are now 101,301 hectares under the ditch—only 4 per cent of the olive lands. In a country as dry as Spain (Figures 7 and 8) this amount is relatively of little importance. The largest irrigated areas are found in Granada (24,469 hectares) where the tree could not be grown in the southern part without it, in Jaén (21,300), Saragossa (12,858), and other provinces along the Ebro valley and the Levantian coast. Outside of 49 hectares in Seville and those of Jaén, there is practically no irrigation in the Andalusian Lowland, the area of olive concentration. In some cases not recorded as irrigated land, small plots are watered by hand or horse power from wells dug in the fields.

A host of insects, diseases, fungi, and lichens plague the olive, and practically all Spanish orchards are infested with one or another. The fungi and diseases are more easily controlled than the insects, which usually have several generations a season, and are thus hard to combat. The losses caused by the olive fly alone, the worst of the many pests, represents about 5 per cent of the value of the average oil yield. Spraying the trees against insects and injurious diseases has hardly reached beyond the experimental stage and is not yet a great factor in combating these plagues. In Seville a mixture of honey, arsenic, and water is sometimes hung in an earthen pot from the branches of the tree, the idea being to attract the fly and destroy it before it attacks the fruit.

In 1932 the government issued several decrees regulating the period between harvesting and expressing the oil, the object being to reduce the possibilities of plagues and to increase the quality of the oil. In addition it now sends out circulars giving the best method of treatment. Though funds were not available for everyone, last year the government loaned money to growers to fight the plague of insects which was prevalent.

Harvest time is a happy time for the olive growers; there are parties and feasting and dancing to the merry guitar. In Andalusia the picking is begun toward the middle or end of October, and in November in the rest of the country. It may last until January or February, but it is usually over by the end of November or the beginning of December. The time of picking varies according to the individual grower and the "color time" he thinks appropriate. In general practice all varieties are harvested at the same time with little attention paid to whether they are completely ripe or not. The harvest is a little earlier in the south as the totally ripe fruit tends to produce a poor-flavored, fatty oil which becomes rancid quickly.

There are three general methods of picking. (1) *A vareo* or poling. The fruit is beaten off the tree with poles and then picked up from the ground. This is done especially in the regions where the harvest is abundant. It not only

bursts the fruit and causes it to ferment and spoil, but striking the tender branches bruises them so that many will not produce the next year. This method is common in Andalusia. (2) *A ordeño* or by picking. The fruit is picked by hand and dropped on cloths which have been spread on the ground. (Figure 9.) This method is quite common in Catalonia, Aragon, Valencia, and parts of Andalusia, and is the usual one of careful orchardists in gathering for the olive presses. (3) *A mano*, by hand. This is the method of picking for the fancy pickling market. The olives are picked by hand and put in a pail or basket hung from the neck or belt of the picker.

The orchards in the pickling districts and especially those belonging to large preserving factories or foreign exporters have the most careful methods of harvesting. Whatever method is used, all the olives are gathered, even those which have fallen to the ground from ripeness or disease. They are then sorted and inspected for size, etc., the dirt and leaves removed, the best reserved for pickling and the remainder sent to the presses.

PICKLED OLIVES AND OLIVE OIL

The olives most desirable for preservation must be fairly large, with a thick pulp and a small, smooth stone which does not adhere to the "meat," and a skin coarse enough to resist the action of the pickling lye. Two varieties, the *gordal* and *manzanilla*, have the greatest reputation as pickling olives, although many others are used.

The olive is not good to eat until large quantities of tannic acid are removed from it. Two processes are commonly used to do this. By one the freshly picked fruit is placed in water which is changed every day until the water drawn off is no longer bitter—about 15 days. The olives are then put in a salt pickle-brine and allowed to stand for about 4 months. This slow process is used mostly for ripe olives which contain too much oil to be treated by lye. In the quick pickling process the fruit is placed in a solution of caustic soda and soaked until the lye has penetrated one-half the thickness of the pericarp (usually 6 to 9 hours). Then the olives are placed in fresh water, which is changed until all traces of the lye are removed. Afterwards they are put in a salt brine and allowed to ferment for two or three months, when they have taken on a fine yellowish green and are ready for market.

For a large part of the fancy export trade and some for domestic consumption, there is still another step in preparing table olives, that is stuffing. This operation, as well as that of preserving, is done in large factories especially equipped for this purpose. They are usually stuffed with pimento. Capers, anchovies, minced ham, and tunny fish are also used, but to a lesser degree all the time. Those to be exported are placed in large containers, although some extra fancy brands are put up in small jars, in salt brine or in pure olive oil.

Of the average 17 million odd quintals of olives raised annually in the last ten years, only about 2 per cent has been devoted to direct consumption. Although each grower generally preserves or pickles a small amount for his own or local consumption and various regions have local factories, the largest center of concentration is in the province of Seville. Here the pickling industry has become famous with its *gordal* and *manzanilla*.

The total pickled-olive export averaged 231,000 quintals annually for the last five years; the United States, Argentina, Brazil, and the Canaries, in order of importance, took over three-

fourths of this. However, exportation has fallen off by nearly a third in the last four years. This has caused pickling olive acreage to come to a standstill. An increase in foreign markets would readily bring an increase in acreage. The possibilities are immense as many sections not now producing pickling olives could very well do so.

There are about 10,000 mills (2,400 large, the rest small) engaged in expressing olive oil. Almost every grower whose primary source of income is from olives has his own mill for making the first (virgin) and often the second pressing oil. Many of these factories are well equipped with scientific machinery. *El Aceite de Oliva* (August, 1932) reports that 97 per cent of the mills are power driven.

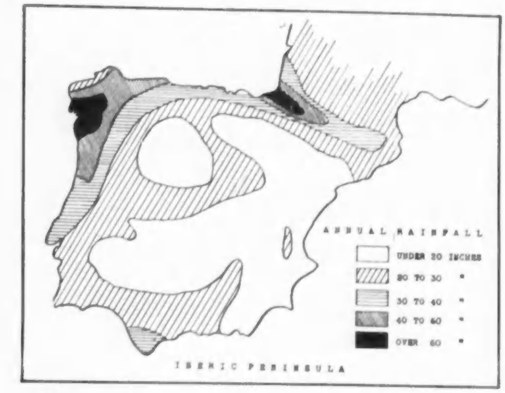

FIGURE 7.—Practically all the olive regions are in sections of less than 20 inches of rainfall, a big factor to be considered by growers. (Based on Semple: *Geography of the Mediterranean Regions*.)

In spite of the large number of mills, they are not sufficient to handle a bumper crop, especially in Jaén, the province of intensest production, nor are they all up to modern specifications. It is said that in years of large production about 90 per cent of the crop is poorly handled there, with the result that the majority of the oil from this province is classed as *corriente* (ordinary) when it should be first class. The mills are not able to handle the crop fast enough and the fruit begins to spoil before it is pressed.

The steps in the oil extraction process are as follows. The whole fruit is washed, ground, the mass placed in pressing bags and then submitted to about one ton of pressure. The oil obtained from this pressing and that which runs from the grinder is called "virgin" and requires no further processing to be edible. When the oil ceases to flow (about 4 hours), the baskets are removed and the paste thoroughly stirred. Greater pressure is now applied. The oil from this pressing is called feeding or yellow oil. It is inferior to virgin oil in taste and quality, having a greater foreign matter content, a slight taste, and more color. The paste now remaining is thrown in boiling water, the pits removed, and the mass again pressed. As this pressing requires extreme pressure it is usually done only by the larger mills; the smaller ones bring in their mash. This oil is rarely edible. The remaining marc still contains some oil—8 to 16 per cent of the total. This is dissolved out with carbon bisulphide, producing what is known as *orujo* (marc) oil which should be used only for industrial purposes. The remaining pomace is used for fuel or fertilizer.

The oil after being expressed is not yet ready for marketing. There is a considerable quantity of vegetable matter which has to be removed. This is done by allowing the oil to settle in "racking" tanks or by centrifugal separators. This simple operation, however, applies only to virgin oil (about two-fifths of the total) and to those oils of the second pressing which are edible as they stand (i.e. with less than 5 per cent acidity). The oils from the third pressing and the *orujo* oil must be rectified or regenerated before they are fit to eat. In this process the acid is neutralized and the color and odor removed.

There is a general, erroneous opinion concerning refined or rectified olive oils which is due partly to ignorance on the part of importers and consumers and partly to unethical business tactics of companies which specialize in rectifying oils. True, natural olive oil is only that which is obtained by pressing or other mechanical means from the whole olive and which has been clarified by means of racking or filtering without any addition of substances or acids which might change its original character. This oil is a golden straw color, somewhat dense, even at times inclined to be cloudy, with the fine original taste of the olive. The consumer and importer with an uneducated "olive" palate and eye is consequently misled: to his tongue, the fruity taste, and to his eye, the cloudiness, are both due to impurities, and, in place of fine oil he buys a flat-tasting but perfectly clear and "pure" oil. This rectified oil, which is wrongly (and often purposely) labeled "refined" easily misleads the buyer into the error of expecting the adjective "refined" to mean super-excellent and select, whereas, in reality, the clear oil has been chemically treated, regenerated, and the true fruit flavor and color driven off.

Rectified oils disguised under the title of "refined" have been one of Spain's big stumbling blocks in international marketing. The Spanish palate, long accustomed to the best oil, demanded a fruity taste, and Spanish exporters naturally believed the world would want the same. They were mistaken, and not having enough refineries (at present there are 30, which is sufficient) at home, they were forced to dispose of the poor oils to French and Italian concerns which rectified the oil, put it on the world market under their own labels, and established a taste in the consumer for "pure" and tasteless oils with which the really pure Spanish oil had difficulty in competing. It followed that Spanish oils had to be sold at lower prices until refineries could be built or the public re-educated to appreciate high quality oil. In 1920, when neither of these ends was accomplished, Spanish exporters had to be satisfied with 67 pesetas per hectoliter of oil, while the French received 153.33 and the Italians 105 pesetas.

Although formerly Spain regularly produced inferior oils it can now market as fine a quality as any country. However, there is still much room for improvement. Much of the oil which is now classified as "common" might just as well be "fine."

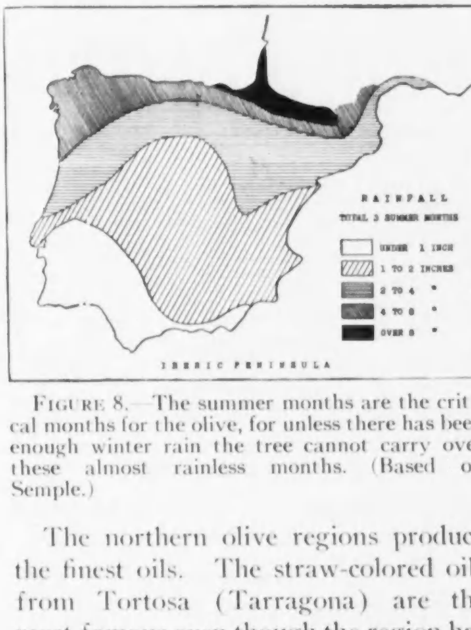

FIGURE 8.—The summer months are the critical months for the olive, for unless there has been enough winter rain the tree cannot carry over these almost rainless months. (Based on Semple.)

The northern olive regions produce the finest oils. The straw-colored oils from Tortosa (Tarragona) are the most famous even though the region has been infested with worms for years and much of the fruit falls to the ground. Lerida oils have a strong yellow color and are the best in Spain for mixing with refined oil. Those from the Ebro valley are very sweet but not as fine as the Tortosan oils. All of these, however, can be marketed without mixing.

The oils of Lower Aragon have the best taste and smell in the world, but at present, the competition of the refineries

and the increased habit of mixing different grades of oil have caused the oil from this region to fall into second place. Consequently, with the incentive gone, the extraction is done less and less carefully.

From the boundary of Catalonia to Murcia all the oil is fit for direct consumption. The oils of Central Spain are mostly *corrientes*. Rapid and careless harvests cause low grades. Most of the Andalusian oils are also *corrientes* although nearly all of that from the Lowland could be fine. Those from Malaga are below medium or *turbios*, industrial oils. Cordova and Seville produce the finest in the region, but Huelva, if methods were improved, might rival Tortosa with its flavors. Except for Malaga and Granada, where it is mostly a matter of excess heat, the low grade of oils in Andalusia is due to all-around poor methods.

THE OLIVE IN SPANISH FARM ECONOMY

There is no ready means of discovering the extent of crop diversification. Olives are grown by general farmers for their own consumption just as apples and cherries are found on many Middle-West farms. It may be generally said that in sections of intensive olive production the orchardist's only agricultural revenue is that from his olive trees. Some forage crops, as oats and barley, may be planted between the trees, and, in some instances, great estates will have areas devoted to several cash crops. In many cases the orchardist raises nothing but his trees, even buying forage for what animals are required. In relatively young orchards, and to some extent in older ones, other cash crops are sometimes grown. But only 15 per cent of the total 2,062,000 hectares under olives grow associated crops. Besides the forage crops, grape vines, almonds, carob trees, horse beans, chickpeas, lentils, and other vegetables are grown according to the climate. The general opinion, however, is that associated crops of any kind are a detriment to an orchard. The northeast, central, and extreme southwestern sections of the country are the regions where associated crops are most abundant.

In regions exclusively dedicated to olive culture the industry becomes typically capitalistic. Many of the orchards are parts of great landed estates, or estates in themselves, owned by wealthy individuals or companies. It is impossible to estimate definitely an average size as they range from 30 to 1,000 or more hectares. In the pickling area around Seville the average is about 200 hectares. The larger growers generally have their own curing plants, mills for extracting the oil, and a few their own refineries. The smaller growers either sell their crops outright to some mill or have the olives cured or pressed on a sharing basis. In some cases fancy exporters buy the olives on the trees and then do their own picking and other preparations for marketing.

Outside of the machinery connected with the mills the orchardists have little other equipment; some farming tools, plows, etc., and a few animals, mules, oxen, and occasionally horses. Most of the work is done by hand. It is estimated that one hectare will require 40 days of work a year.

About half of the rural population of Andalusia is dependent upon the olive industry for a livelihood. Mr. Richard Ford, American Consul at Seville, reports that he would consider a half million as a conservative estimate of the number employed in the industry in Seville, Cordova, Malaga, Huelva, and Jaén. A medium-sized orchard, in normal times, employs 20 to 40 workers, which number is increased to 50 or 60

during the harvest. The regular employees are paid at a fixed rate per month or year. In some sections the orchards are job-lotted to families or contractors or are run on a sharing basis. The ordinary laborers are paid from 6 to 10 pesetas a day. At harvest time they are often paid on a piece work basis, so much per quintal of olives picked or even so much per hectare. In this case whole families join together and the women and even the very small children lump their efforts. A harvesting group like this is called a *banco*, or "bank." The laborers are almost always recruited from the surrounding community, although specialists in pruning or in treating diseases may come a considerable distance.

There is no general category in which to place olive growers; they range from former nobility to the poorest peasant. Though they are probably as well off as any one else in Spain in a comparable position, at present they are all hampered by the depression. As for the workers, their lot is not so good. Their standard of living is far below American standards and even below that of peasants in northern European countries. A large proportion of them subsist, especially in the summer, on hardly anything but bread, garlic, and olive oil. It is only to the healthful qualities of the olive oil that they owe their existence; however, even on this meager diet they are usually merry, robust, and frequently long lived.

Reliable figures for the cost of production are not available. Latorre (*El Cultive del Olive:* pp. 376–77) estimates the cost for one hectare which contained 90 trees from 70 to 80 years old to be 395.25 pesetas for a year, while the income was 492.75, leaving a net of 97.50 pesetas, or about $14.00 at the present exchange. On the whole, the cost of production in Spain is relatively lower than in other countries.

FIGURE 9.—Harvesting a ordeño in Tarragona. Notice the cloth in the right foreground onto which the olives are thrown after being picked. (Courtesy *Ministerio de Industria y Comercio, Oficina del Aceite,* Madrid.)

REGIONS OF PRODUCTION

The region of greatest olive concentration includes the Andalusian Lowland and a considerable amount of the slopes of the Sierra Morena, to the north, and the Sierra Nevada, to the south. The southwest coastal plain is

excluded because of the swamps (Las Marismas). In general, the climate of this whole region is exceedingly favorable for the growth of the olive. The temperature never drops low enough to kill it out nor goes, ordinarily, high enough to dry it up. Although there is considerable irrigation in Jaén, olives can be grown in the entire region on dry farms.

The eastern division is more suitable climatically than the western. Temperatures are not so extreme, the rainfall is higher (23 inches at Jaén), and the winds blow from the east. As one progresses westward through Andalusia the temperatures rise—Seville averages about 3 degrees higher than Jaén—and the rainfall goes down (Seville 22 and Bádajoz 18 inches). The southwest end of the Lowland is the least favorable for the olive. The land is rougher and the soils poorer.

The provinces of Jaén and Cordova are the most productive. In 1928–29 they produced 59,347,500 and 24,494,400 kilograms of oil respectively. Twenty per cent of the land of Jaén is in olives, and this crop usually averages over half of the total agricultural income for the province. The dominant feature of the landscape is the olive tree; it excludes nearly all other trees in most of the Andalusian Lowland.

The southern littoral is, in general, unfavorable climatically for the olive. The hot winds blowing from the Sahara raise the temperature so high that the oils obtained are fatty, coarse, and usually not edible. The narrow Granadine coast land gives little room for the olive; the low rainfall in Malaga, only one inch in summer, and in Almeria, only 8 in the entire year, make irrigation necessary.

The entire southeastern coastland is subject to periodic droughts which make production erratic. Murcia and Alicante each have about 5,000 hectares of olives in irrigation; Valencia and Castellon have only some 700 hectares between them, the irrigated land being used for more remunerative crops, oranges, etc. In some years the rainfall drops to 5 or 6 inches, much too low for the olive. It tends to increase toward the north, and the olive production with it. In Murcia the acreage has been decreasing, while there has been a tendency to increase in the other provinces. Because of the natural difficulties the trees are generally better cared for in this region than in the Andalusian Lowland.

Almost all of the northeast maritime zone is well adapted to the olive. The temperatures are rarely low enough to do severe damage but still average high enough to produce the world-famous Tortosan oils in Tarragona. Compared to the Levantian coast the rainfall is fairly high. In summer it is enough to prevent drought. In the northern inland sections the olive fades out with altitude and cold. Here the tree is only successfully grown in deep valleys which get the southern sun. In 1926 a bad winter killed out many trees in Lerida and the general tendency now is to retreat from unfavorable situations. In some parts of northern Barcelona the olives have been replaced by vineyards. The provinces of Tarragona and Lerida comprise the second most important olive region in Spain (Figure 6).

A considerable number of hectares are in olives on the middle slopes of the Ebro basin. Above these, both to the north and south, severe cold entirely prevents its growth. In 1888 great stretches of olives were eliminated in Saragossa by the frosts. Because of general unfavorable weather the olive is unimportant in this region.

The South-Central Plateau is broken up by several mountain chains which so diversify the climate that it is impossible

to give a clear generalization for a very large region. In many places the olive runs the risk of being frosted out. The rainfall is generally higher than on the south and east coasts but what this might add to production is cut down by the poor soils. The famous *almendrilla* is abundant. The olive is most important in Toledo and Ciudad Real, fading out as the altitude rises to the north, east, and west. In Caceres vineyards destroyed by the philoxera are being replaced by olives. In most of the remaining territory there is a tendency to decrease the acreage and to replant old trees with vines.

If a line were drawn from the southwest tip of Salamanca to the southeast point of Soria and from there directly north it would pretty well include all the provinces in which the olive is absolutely absent or very unimportant (Figures 5 and 6). The marine west-coast type of rainfall in the northwest provinces rules it out there, and the severe frost does the same in the other provinces. Where it exists it is found in river valleys which are well protected from the cold. In most cases it is grown for local consumption.

The olive is quite extensively cultivated in the mountains of Majorca where both temperature and rainfall are quite favorable. It is hardly grown at all on Menorca because of the severe winds. However, acreage is decreasing on the islands; the olive is poorly tended and badly harvested, and other trees which produce more certainly, such as almond, carob, and fig, are continually replacing it.

SPANISH OLIVE OIL ON THE WORLD MARKET

The olive is grown in all the countries bounding the Mediterranean Sea (Figure 5), Portugal, New Zealand, Australia, the United States, South America, Madagascar, China, Burma, Malacca, Abyssinia, India, Afghanistan, Transcaucasia, and the south coast of the Arabian Peninsula. However, all the countries outside of the Mediterranean basin produce only one per cent of the world crop. Europe produces 90 per cent and the remaining 9 per cent is scattered among the other Mediterranean countries. Spain outranks all countries in acreage, production, and exportation (Figure 1).

FIGURE 10.—Olive bags ready to be carried to the pressing mill. In the background a Catalonian orchard. (Courtesy *Ministerio de Industria y Comercio, Oficina del Aceite,* Madrid.)

Although every country that produces and exports oil or olives may be classed as a Spanish competitor, the countries which have been Spain's most serious rivals are Italy, and France, and of late, Greece, Tunis, and Turkey.

Two-thirds of the world consumption of olive oil is concentrated in the producing countries. Outside of these, the consumption is generally very small per capita. For example, in the United States, the greatest olive oil importer, the average consumption per person is only a trifle over .09 kilograms a year, while it is about 5 in Italy, 12 in Greece, and 15 in Spain.

The average Spanish production of oil is 3,400,000 quintals annually (Figures 1 and 4). Of this about 2,600,000 is consumed domestically, mostly in the olive provinces, leaving about 800,000

quintals for the export trade. As the home consumption does not increase proportionately with the increase in production, this figure is considerably larger in years of a bumper crop. The domestic consumption of table olives is much less proportionately than the oil consumption, averaging less than 2 per cent of the crop.

Since 1884, when exportation first exceeded importation, the increase has been gradual but erratic. For many years Spain, because of carelessness, lack of drive and business technique, failed to secure markets which could have been hers. Also, Spanish oils have been, and certain brands still are, too acid, gross, dark-colored, and strong tasting for those uninitiated to "straight" oil.

The hardest thing for Spanish exporters to overcome has been old established trade traditions. France and Italy were firmly established in the export trade long before Spain became important, and their brands, backed by the traditional stories about their prowess in the culinary art, became famous throughout the world. The head start of the other countries in the refining business (first Italian refinery 1912) was also a handicap. In reality, there has been no vital reason why Spain could not have been the world's greatest exporter for the last 30 years.

Greece is the only olive exporter to compete to any extent with Spain, but her market is mostly limited to a type to which Spain has not made an effort to cater. On the other hand, a considerable advance in acreage in orchards producing oil has had a direct effect on Greek oil exports, especially to Italy. From 1930 to 1932 Greek exports to Italy quadrupled. This tremendous increase, coupled with the decrease in Italian markets, practically squeezed Spain out of Italy. In 1931 Italy took 33 million kilograms of Spanish oil; in 1932, mostly under pressure of Greek exports to this country, this fell to 6 million, and in 1933 to 150 thousand. If this condition continues, the entire Spanish export system will need to be reorganized, new trade agreements made, etc.

When Italy was importing tens of millions of kilograms of oil yearly from Spain she was Spain's greatest customer and her biggest competitor. In 1933 she became strictly another competitor, and a most threatening one, because she was competing with Spain, not with Spain's own oil, but with oil from Greece, Turkey, and Tunis.

Italian exports have for a good many years been, in reality, foreign oil being reëxported. From 1927 to 1930 only 9.59 per cent of Italy's oil exported was native oil. During this period Spain was already losing out in the Italian market, and her total export has dropped steadily since 1928. A good deal of the decrease is due to the depression, but Spain has fallen off much more, proportionately, than Italy. Whereas in 1928 Spain exported 120 and Italy 44 million kilograms of oil, in 1931 Spain exported 93 million, while Italy had dropped only 300,000 of her exports. By 1933 Spain's export had decreased to 43 million kilos. This drop is due to her inability to find new markets for oil she no longer sells to Italy; the drop in her other export markets is not as low, proportionately, as Italy's. Italy has several factors in her favor in holding a foreign market or even encroaching upon Spanish markets. Her business technique is more effective; in fact, it was due to this that in 1920 she superseded Spain as the greatest exporter to Brazil. The balance of trade is more often in favor of the country importing from Italy than from Spain, and of late years Italy has been able to drive harder bargains in trade agreements.

Instead of favorable trade agreements Spain has had to try to overcome increasingly high tariff walls. In addition, many of the South American states are slow in paying their exchange bills, a matter which demoralizes the exporters with limited capital. On the other hand, Italy sends her largest amounts to the stable countries of Europe and North America. Also, Italy can handle its oil cheaper than Spain, and can, if necessary, undersell. In 1932, to hold its trade with Argentina, it sold olive oil in Buenos Aires at a lower price than the cheapest quoted on the market in Genoa.

In good years Spanish exports of oil reach a value of 300,000,000 pesetas, with only oranges exceeding this in value. Until recently Italy (Figure 11) has been the greatest importer, the United States second, and Argentina and Cuba third and fourth respectively. The lower-grade oils went to Italy to be "refined" and the better grades to the various countries shown by Figure 11. Seville and Barcelona are the two largest exporting ports; practically all green olives leave Spain by way of Seville. Malaga, Alicante, and Valencia ship small amounts of oil.

THE PROSPECTS OF THE OLIVE INDUSTRY IN SPAIN

Both internally and externally the Spanish olive industry is today at a critical period. The growers and exporters are very conscious of this fact but not, as yet, enough so that they will wholeheartedly act as a body to overcome it. The olive growers are primarily individualists when it comes to their farm activities. They are, on the whole, against coöperative marketing or concerted group action in organizing methods, establishing standards of quality, etc. The National Association of Olive Growers of Spain, with coördinate groups, has done considerable along this line, but there are not enough members (8,747 in 1933) as yet to create sufficient political weight to carry through the required legislation for reorganizing the industry. The exporters, although they have an organization like that of the

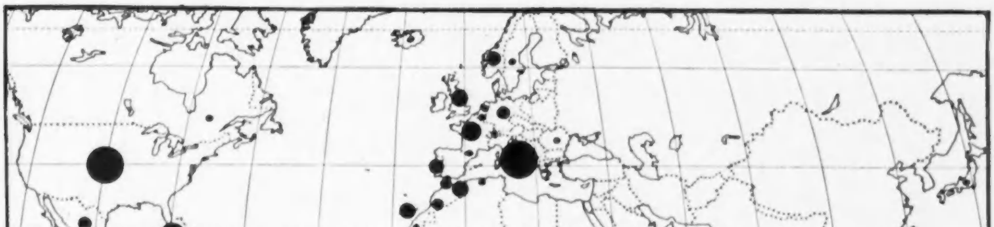

FIGURE 11.—Principal countries importing Spanish olive oil. This figure is based on the average of the last several years. At present Italy imports a far smaller amount. The Norwegian import is absorbed by the fish canning industry.

growers, are just as individualistic. Consequently, many small concerns struggle over difficulties which a large organization could easily resolve.

The future success of the industry on the world market seems to depend largely on the accomplishment of the following points: the establishment of favorable trade agreements; the organization of the growers, setting definite rules about quality of oils, mixing, processing, etc.; the organization of the exporters, lumping their efforts, their advertising facilities, and establishing uniform brands of superior qualities, and the prohibition of the importation of other oils which can more cheaply be replaced by native olive oil. This will make an outlet for *orujo* oil and revive the refining industry.

There is no general indication that any of these ends will be accomplished very soon, if at all. However, there is considerable agitation upon the part of the more intelligent growers and exporters. It will be up to them to draw the rest in line, or Spain may decline into another Greece, supplying oil to some country which takes the cream of the exportation market.

HOP INDUSTRY OF THE PACIFIC COAST STATES

Otis W. Freeman

HOPS represent a very specialized agricultural industry. The bulk of the crop is produced by the never numerous, large-scale producers. During the picking season even small-scale growers require very many workers, so that while the number of growers is limited, the hop industry has much importance as an employer of seasonal labor.

The price of hops is peculiarly subject to extreme fluctuations. Partly this results from an overextension of the industry during times of high prices. Also markets are variable, depending on demand abroad and consumption by brewers within the United States. The acreage suitable for growing hops on the Pacific Coast could produce vastly more of the product than the market can consume. Such conditions require skillful management on the part of hop growers and only the most efficient can survive the competition.

Natural Requirements for Hops

While hop plants will grow in most parts of the United States, their commercial production centers in limited areas of Oregon, Washington, and northern California. New York produces a small quantity to lead the eastern states, but the industry so declined by 1929 that only five farms reported hops as a crop in New York that year. Few crops have a more sharply localized distribution than hops (Figure 1).

Hops require deep, easily worked, fertile, well-drained soils. Heavy surface soils would hinder cultivation, and heavy clay sub soil would interfere with the root system of hop plants that widely penetrate many feet in search of food. The climate should have mild winters to prevent winter killing of hops, and sufficient rain in summer without too much dampness and fog that favor development of injurious mold and insect parasites. In sections lacking summer rain, like California and eastern Washington, irrigation supplies needed water to the hops.

Hop Culture

Hop vines can be raised from seeds, but cuttings from strong, productive plants are usually employed. Experience shows that seedlings vary too much in quality and time of maturity besides not yielding hops the first year and only a small production the second year.

The best cuttings come from young plants. These are more resistant to disease and produce larger yields than from old plants. The cuttings come from sections of runners sent out by a hop plant just below the surface. Each section planted should have two buds called "eyes." The cuttings are secured during pruning operations in the spring. Improvement in yields and uniformity in quality can be secured by selection of cuttings only from superior plants which may be marked at harvest season for that purpose.

In the Willamette Valley of Oregon and the Yakima Valley of Washington, the planting of hop cuttings takes place in March or April. This operation can be done earlier in California. Hills of the cuttings are placed in rows, usually 8 feet apart in each direction. When so arranged, 680 hills cover one acre. In California hops are set in rows at a distance of 6½ to 7 feet each way, and 900–1,000 plants are needed per acre. Three and sometimes four cuttings are set with buds pointing upright in each

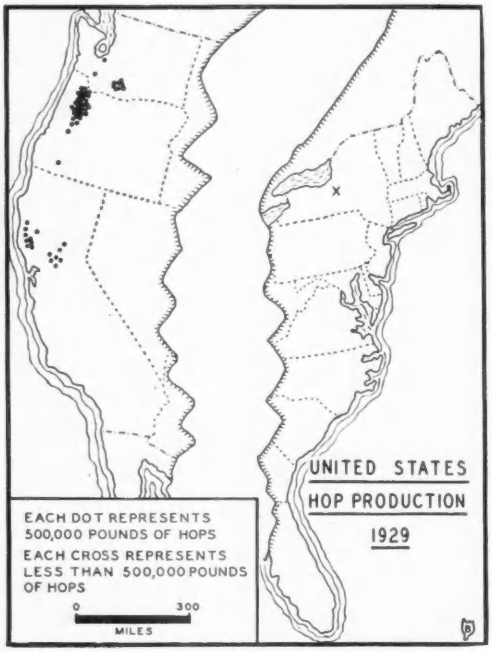

FIGURE 1.—At present the chief hop producing regions are on the Pacific Coast. The New York section, which once was so important, is likely to resume its hop production if demand and growing conditions permit. The Willamette Valley of Oregon produces by far the larger part of the crop.

hill, covered with about 3 inches of soil. Root cuttings are sometimes started for a year in nurseries. Such plants are called "crown roots" and command better prices than new cuttings.

Labor in the hop yard begins early in the spring. First cross plowing of the field pulls the dirt away from the hills which are left as small undisturbed squares of earth. The roots are uncovered with hand hoes, and the extra roots and runners along with about one inch of the top of the root are pruned off with a knife, after which the rootstock of the hill is covered with 3 inches of soil. Some growers use sharp spades to cut each hill down on a slant, leaving them 4 inches square on top and about 12 inches on the bottom. Proper pruning produces fewer but stronger vines with longer arms and more cones.

During the summer frequent cultivation of the ground keeps down the weeds, limits evaporation, and improves the tilth of the soil. When grown in the Yakima Valley or California, the growing vines are irrigated when necessary. Late cultivation requires care to prevent damage to the shallow feeding roots of the vines that develop when the hops go into the burr. Injury to the feeding roots may prevent young buds setting well and may cause a short crop of early maturity.

Hop vines must have poles or strung wires provided on which the plants may spread. Poles are used by some growers, but trellises are preferred by the majority of men. Growers claim the following advantages for the trellis: (1) The hops remain healthier, (2) spraying against the aphis and other pests is easier, (3) the hops mature earlier, (4) the cones have better color, (5) the cones are easier to pick and can be picked cleaner, (6) vines do not require cutting which would weaken the stock by loss of material that otherwise returns from the vine to the root.

In the high trellis system posts are set every fourth or fifth hill and extend 12 or 15 feet above the ground. The bottom of the posts may be creosoted to make them last longer. Wires are stretched over the tops of the posts across the yard each way at right angles. Above the hills not covered by the main cross wires, extra wires are strung from the wires supported by the posts. Anchors keep the system of wire taut. A high trellis costs about $100 per acre. Twine to support the vines runs from stakes set at each hill to the wires. The strings cost about $8 per acre annually.

In windy locations lower trellises about 8 feet high are used, but the crop labor cost is more than on the high trellis, since a hop vine will not follow a horizontal support and must be trained by hand along the more numerous strings

or wires required on the low trellis. The drooping arms of the hops trained on low trellises may interfere with cultivation.

Men begin training the vines when they have grown to about 2 feet in length. Usually four to six of the best runners are left and the rest removed. Generally two runners are trained on each string that carry the vines to the overhead wires. Some growers also train the hop vines overhead on cross strings. This exposes the hops better to the rays of the sun and retards vine growth which produces more hops.

The yield of dry hops in the Yakima Valley averages 1,800 to 2,000 pounds per acre, but exceptional fields yield up to 4,000 pounds of dried hops per acre. This is generally the highest yield of any section in the United States. From 1924–1930, Washington averaged 1,944 pounds of hops per acre, California 1,667 pounds per acre, and Oregon 1,084 pounds per acre. Of course in Oregon, hops are not irrigated and, while yields are lower, costs also are lower than the irrigated fields.

FIGURE 2.—Hops growing in a hop yard in the Yakima Valley. These hop vines are grown by the high trellis system. The soil must be fertile and well drained. Level land is also essential in the Yakima Valley where irrigation is necessary. (Courtesy of W. H. McCullough, Yakima, Washington.)

The fruit of the hop vine is technically called a cone or strobile. Some call it the bud or blossom, but mostly people speak of the cones as "hops." Ripe hops have a crisp feeling and give out a rustling sound when crushed. Mature hops are elastic and, if lightly compressed, will return to the original shape when released. Generally hops are yellowish green when ripe.

Hops should be picked clean since the presence of leaves and other trash reduces the market price. Unripe hops should not be gathered as they have a high water content and are difficult to dry and do not keep well in storage. The resin and lupulin content is smaller than in the ripe hop and aroma is not well developed.

LABOR

Each hop grower needs a large number of employees during the hop-picking season. A grower and his family can manage to handle most of the work in the hop yard during the season except when the cones have ripened. In the Yakima Valley of Washington the labor comes from several sources of which the most important are: local residents, Indians from the Yakima Reservation and transients. Some of the local laborers are Americans, others are Orientals, especially Filipinos. The Indians come as family groups and have the reputation of being fast, reliable workers. Generally when Indians are employed, no one else is given work at that yard. In 1934 over 3,000 Indians picked hops in the Valley during the three weeks' picking season. The transients belong to the group called "fruit tramps," familiar to Westerners. A decrepit car or truck

carries a family and their camping equipment from one temporary job to another. The children early learn to dodge the truant officer and grow up with a minimum of education and home life. Such transient labor proves of use to fruit and hop growers, but constitutes a social problem of real concern.

During the picking season the hop pickers camp with their families in tents on a portion of the yard of the owners. The nondescript appearance of such a camp resembles that of a group of refugees. The cars, tents, bedding, clothing, cooking devices, dogs, and people seem worn out and ready to be discarded. Indians never give an employer difficulty, but labor troubles with transients and Filipinos are common in some seasons.

The hop cones are picked into portable sacks that are weighed and collected by the owner. Pickers receive piece rates for picking, 2 cents per pound being a usual price. In 1935 low prices of hops caused growers to pay only $1.25 to $1.50 per hundred pounds. Skilled pickers have been known to pick 300 pounds of hops in one day, but the average is about half that. Good workers earn $3.00 or $4.00 per day. The hop industry puts nearly $4,000,000 per year into the pockets of the West Coast workers.

CURING

The curing of hops affects their quality more than anything else and therefore requires experience and exceptional care. The curing process is carried on in kilns with the object of so reducing the moisture content of hops that they can be stored without deterioration.

Various types of kilns have been constructed to cure hops. The most common type is a square wooden box structure from 30–40 feet long on a side and nearly as high, with a steep pyramidal roof ending in a 6- or 8-foot square ventilator about 10 feet high above the peak of the roof. A drying floor, built 20 feet above the ground, holds the hops which are dried by the heat from a stove or furnace below. Natural draft is depended upon to dry the hops, and on hot summer days this is not very efficient. A new type of air-blast kiln has a fan that forces a current of heated air through the structure. Some late installations have an automatic oil furnace that generates steam which heats air forced over the steam pipes by a fan. Most kilns, however, use wood-fired furnaces usually placed so that firing can be conducted from outside. Frequently two kilns are built together and sometimes as many as four have been placed side by side.

The floor of the kiln is covered with wire netting or burlap that admits the heated air while making a firm support for the hops. A platform for loading and unloading the hops extends outside along one face of the kiln.

Fresh hops from the field contain 65–75% of moisture which must be reduced in the kiln to 10–14% of moisture for safe storage. The hops are loosely scattered evenly over the floor to a depth of 18–24 inches, sometimes 30 inches in air-blast kilns. If packed too tight or too deep, the lower hops may be scorched by overheating while others may not be dried enough. Hops may be cured in 10 or 12 hours, but the usual time is 18–20 hours. The best temperatures for drying lie between 100° to 140° F. Usually drying the hops slower at the lowest temperatures that will do the work produces the best quality. Various factors control the period of drying necessary, such as: (1) degree of heat, (2) volume of air passing through the hops, (3) moisture content of the hops, and (4) humidity of the air.

Well cured hops must have a fine physical appearance. Buyers demand a yellowish green color. In practice growers bleach the hops with sulphur burned on top of the furnace at the rate of 1–4 pounds of sulphur to 100 pounds of undried hops. Besides improving the color of the hops, sulphuring destroys microörganisms, improves the keeping qualities of the hops and some believe accelerates the drying process.

Dried hops should be so cured as to contain certain principles that determine the value of the product, such as: tannin found mostly in the bracts of the cone, the soft resins, the volatile oil, and certain bitter compounds that occur chiefly in the lupulin. When properly cured, the stems and cones of hops should be shriveled but still soft and pliable. If overdried, hops break badly into chaff and give off a burnt odor. When underdried, hops may ferment and develop a sour, musty odor that renders them useless.

After curing, the hops should be quickly cooled for which some growers provide a special cooling floor where the hops go through a "sweating" process, during which some moisture is absorbed from the air which takes a week or ten days. When, through lack of storage space, hops are baled too soon they may develop an unpleasant sour flavor. Hops may be stored in bulk for some weeks if the warehouse is tightly closed to exclude atmospheric moisture. To bale hops they must have absorbed some moisture so that they resist breaking when compressed. Baling is accomplished by either hand or power presses. Each bale is enclosed with jute bagging. A bale of hops weighs about 200 pounds. A carload contains about 125 bales. In carload lots of 25,000 pounds the railroad rate is $1.77 per cwt. to the Eastern Coast, and the boat rate from a Pacific port to an Atlantic port is $1.10 per cwt. plus insurance and wharf dues.

FIGURE 3.—Picking hops in the Yakima Valley. The picking is done mostly in September. Notice the type of canvas basket used by the workers. These hop pickers are all full-blooded Yakima Indians. (Courtesy of W. H. McCullough, Yakima, Washington.)

The quality of beer depends in part upon certain constituents of hops. Hops especially need soluble resins for brewing. Pacific-grown hops have proved very high in content of the soluble resins. These have been named alpha resins and beta resins. Some tannin and lupulin is also required.

PRESENT CONDITION OF THE HOP INDUSTRY

The year 1935 found the hop industry over-expanded. Legalizing beer caused high prices for hops. This in turn stimulated the planting of much new acreage and enlargement of existing hop yards. But in two years it developed that brewers had overestimated the consumption of beer in the United States, and some brewers refused to accept delivery of hops contracted for. In the Yakima Valley, where production of hops doubled from 1932 to 1934, a large firm of middlemen faced bankruptcy because it had agreed to pay growers a good price for hops in the fall of 1934 and then could not secure payment under its contracts with brewers. Efforts to get hop growers to accept code regulations and reduce acreage have not yet succeeded. It appears that the least profitable yards must be abandoned and production decreased before hop prices will again rise. Following the World War, millions of pounds of hops were exported to Europe and prices averaged 25 to 66 cents per pound from 1919 to 1921. When European producers again supplied their brewers with hops at a cheaper price, exports rather steadily declined. With less of the crop going abroad, lower prices for hops resulted. The crop brought 12 cents per pound in 1929 and 1930. The repeal of the 18th Amendment again boomed prices. Now the industry has to struggle once more with over-production and resulting low prices.

FIGURE 4.—Type of kiln used for curing hops. Notice the loading platform and the pile of wood for fuel in heating the kiln.

HOPS IN THE YAKIMA VALLEY, WASHINGTON

The Yakima Valley in south central Washington comprises one of the most productive agricultural areas of the United States. While irrigation is required because of deficient rainfall, an abundance of water is available from the Yakima River and other streams that have sources in the Cascade Mountains. The term "Yakima Valley" includes both the Yakima and its tributary valleys that are usually separated from each other by barren hills or ridges covered with sage brush. Four miles south of the city of Yakima, two east-west running ridges divide the "Yakima Valley" into two nearly equal divisions. The narrow pass between the ridges, occupied by the Yakima River, railroads, and highways, is called "Union Gap." Crops differ somewhat in the two halves of the Yakima Valley with hops, a highly specialized crop, being grown only in certain parts of the upper valley especially around Toppenish and Moxee City.

The Moxee Valley forms the best type region intensively devoted to hops. This valley lies about 1,000 feet above the sea and is bounded on the north by Yakima Ridge and on the south by Selah Ridge that rises 800–1,200 feet above

the valley. Eastward Moxee Valley disappears as the ridges approach each other, westward the valley merges with the floor of the main upper Yakima Valley.

The soil is a few feet to over 60 feet deep with gravel underneath. In most places the depth to the bed rock, basalt, is considerable. The soil is rarely residual, mostly it has been formed from lake deposits. A lake during part of the Tertiary period and one near the close of the glacial epoch appear to have covered much of the valley. Some volcanic ash is mixed with the silts and sands of the valley. The U. S. Bureau of Soils states that 75.7% of the Yakima Valley area is covered with the Yakima sandy loam. This soil is deep, light, friable, high in fertility, easy to till, and generally well drained; it prevents accumulation of alkali which is destructive to hops. Hops are raised almost exclusively on the non-gravel phase of the Yakima sandy loam.

Most farmers that grow hops around Moxee have 15 to 20 acres in the crop with a few large-scale producers. Only part of the farm is usually planted to hops. The land is served mostly by irrigation ditches; a few growers in the east end of Moxee Valley have artesian wells or pump water.

A majority of the hop growers in Moxee Valley have French-Canadian or Dutch ancestry, other nationalities are rather scattered. Special experience and skill are needed to grow hops, and successful owners tend to remain on their farms and are little inclined to sell them. The hop is a perennial plant and some yards are still producing hops from plantings made thirty years ago.

Both male and female hop plants occur in nature. When the plants are mixed, the pollination produces seed cones. One male hop will fertilize 100–200 female plants. If the male plants are excluded, seedless cones result. Since new fields are planted from cuttings in the Yakima Valley there is no advantage in raising seed cones, and the usual practice is to produce the seedless form of hops since the seeds contain tannin and brewers assess a penalty for hops containing over a certain quantity of tannin.

Out of 4,878,000 pounds of hops raised in 1929 in Washington, Yakima County produced 4,045,000 pounds. The balance came from Pierce County with 639,000 pounds, and Lewis County with 195,000 pounds of hops. Conditions in Pierce and in Lewis counties in western Washington, between the Cascade Mountains and the Coast Range, are similar to the Willamette Valley.

HOPS IN OREGON

The state of Oregon leads the Union in production of hops. Yearly production now averages around 90,000 to

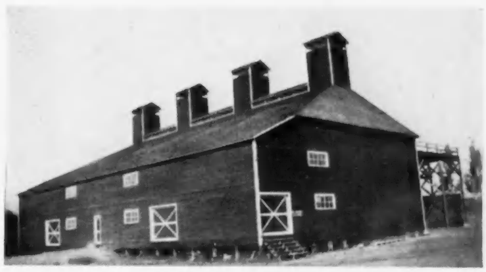

FIGURE 5.—Battery of four kilns used for curing hops.

110,000 bales in Oregon, 50,000 to 55,000 bales for California and 40,000 to 50,000 bales in Washington. A bale contains about 15 cubic feet of closely pressed hops and weighs about 200 pounds.

Practically all of the hops in Oregon grow in the Willamette Valley. Three-fourths of the crop is concentrated in two counties: Marion and Polk. Salem is the leading center for marketing and distributing the crop. Outside the

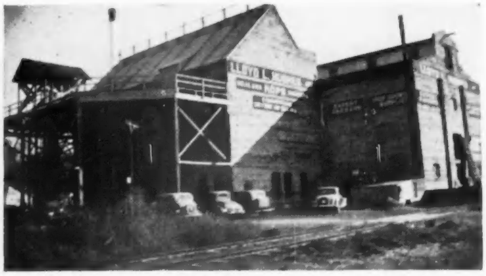

FIGURE 6.—Modern plant built of concrete, Moxee, Washington. This is used for curing, baling, and storing hops.

Willamette Valley, only a small acreage near Grant's Pass in Rogue River Valley of southern Oregon raises hops, and the crop there amounts to less than 2% of the state total. A high degree of specialization characterizes hop production in Oregon. In 1930, according to the Oregon Agricultural Experiment Station, only 535 farms raised hops, which amounts to barely 2% of the farms in those counties that raise hops commercially. Furthermore, a few large producers account for much of the crop, since 34 farms (6.4% of the total) had over 80 acres, each in hops that represented 33.5% of the state acreage. Thus one-sixteenth of the hop yards had a third of the acreage. On the other hand, 380 farms had under 30 acres in hops. These small hop yards represent 71% of the farms but only 32.2% of the acreage. Farms with 30 to 80 acres in hops represented 22.6% of the farms and 34.3% of the acreage. Since some hop growers handle more than one "farm," the number of growers is under 535, the number of farms growing hops. Owing to ravages of pests or to prices below cost of production, it would seem desirable for growers to have other crops to lessen the risk involved. Some growers have walnuts and fruits or raise hay and grain for dairy cows and other livestock, but in general the chief source of cash income to a man growing hops comes from that crop. In many cases hops form the only money crop raised.

In planting hops, fertile alluvial soil on the bottom lands is preferred. About two-thirds of acreage is planted on youthful alluvial or bottom land soil, chiefly classified as the Chehalis and Newberg series by the U. S. Bureau of Soils. Most of the remainder of the hop yards have a location on the floor of the main Willamette Valley and represent older valley fill soils included in the Willamette and Amity soil types by the Soil Bureau.

In 1929, out of 15,863 acres in hops harvested in Oregon, 10,209 (64.4%) grew on bottom lands, 5,091 acres (32.1%) on the main valley floor and 563 acres (3.5%) on residual soils or hill lands. Since the recently formed soils of the bottom lands are more fertile than the others, hops yield best there. In 1930, according to George L. Sulerud of the Agricultural Experiment Station at Corvallis, yields of Late Cluster, the best producing variety of hops grown in Oregon, totaled per acre, 1,188 pounds on bottom lands, 975 pounds on old valley fill soils, and 829 pounds on hill lands.

Since conditions vary widely at different hop yards, the cost of growing hops varies accordingly. In 1930 a survey by Sulerud showed costs between 11 cents and 17 cents per pound for hops including labor, taxes, interest, etc. The actual cash outlay ran between 8 cents to 15 cents per pound. When hops sell under 10 cents per pound, as happened in the summer of 1935, growers obviously lose money. Of course when hops bring 20 cents or more per pound, even high-cost producers make money. Low prices cause hop yards to be abandoned and part of the crop to remain unpicked. High prices cause remarked operation of abandoned hop yards and planting of new yards. The hop-growing industry must be regarded as quite speculative

and, to make money, a grower must be a good manager and be well financed. Yet the industry has generally proved profitable in Oregon, since the number of growers of hops more than doubled from 1919 to 1929.

Hops in California

Hop production in California declined a third from 1919 to 1929. The state dropped from first place in 1919 to second place in 1929 in both acreage and total production of hops. Since hop acreage more than doubled in Oregon and Washington during the same decade, the returns from hops must have been unsatisfactory to California producers. Yield per acre is smaller in California than in the Yakima Valley of Washington and costs are generally higher than in either Oregon or Washington.

Only 93 California farms reported hops in 1929 for the census; 4,144 acres were in hops. This gives an average of 44½ acres of hops per farm, which exceeds the average for Oregon of 33.8 acres per farm and for Washington of 17.6 acres. A few large producers account for much of the California output of hops. Sonoma County leads in hop production with 3,000,000 pounds or 38% of the state total. Other counties that produced over a million pounds of hops were Sacramento and Mendocino. Yolo and Yuba counties each produced around 800,000 pounds of hops.

The two leading sections growing hops in California are (1) the Sacramento Valley and (2) Coast Range valleys north of San Francisco Bay. Conditions in the lower Sacramento Valley are favorable since the soil consists of fertile alluvium, there is good drainage, and water is available for irrigation. Both alluvial and residual soils are used for hops in fertile valley lands on the leeward side of the Coast Range between Santa Rosa and Ukiah. Hopland in the Russian River Valley has some large hop yards.

HOPS, BY STATES, CENSUS OF 1929 AND 1919

	Farms Raising Hops		*Acreage*		*Production (000 Pounds)*	
	1929	*1919*	*1929*	*1919*	*1929*	*1919*
Oregon	483	207	16,327	5,629	18,446	4,788
California	93	144	4,144	8,118	7,906	12,610
Washington	160	76	2,814	1,129	4,878	1,616
New York	5	162	17	1,024	8	724
Total U. S.	741	683	23,302	15,954	31,238	19,761

The total for 1919 includes 23,000 pounds for other states in which no production was reported for 1929.

OREGON LOW-LANDS SUITABLE FOR FLAX

Charles Sumner Hoffman, Jr.

SOIL surveys by the U. S. Department of Agriculture, in coöperation with the Oregon Agricultural College Experiment Station, show that over 500,000 acres in eight counties of the Willamette Valley are suitable for the raising of flax.

The area holding the land best suited for flax growing is compactly situated in the heart of the valley. There are additional flax productive acres outside this section. The milling units are being advantageously situated in the immediate area of the flax land, eliminating long hauls of the raw product and thereby reducing manufacturing costs.

The following table shows the total area and the climatic conditions of the eight counties in the flax growing section of the Willamette Valley:

heavy in texture. The recent alluvial soils have been found to be most satisfactory for this crop. Of these, the Chehalis (Composition: Potassium 24.08% ; Calcium 48.5% ; Magnesium 20.11% ; Phosphorus 2.79% ; Sulphur .51% ; Nitrogen 4.01%) is the best and the Willamette (Composition: Potassium 46.2% ; Calcium 30.43% ; Magnesium 17.99% ; Phosphorus 3.14% ; Sulphur .0023% ; Nitrogen 1.94%) the second best types.

The Chehalis series, including approximately 200,000 acres present in the eight Willamette Valley counties, is the most extensive type of soil and is representative of the recent stream-bottom series of the Willamette Valley. These recent soils are nearly neutral in reaction and are well supplied with calcium and potassium. The sulphur content is low.

TABLE I

County	*Acres*	*Mean Annual Temperature (Fahr.)*	*Rainfall*	*Average Length of Growing Season*
Benton	414,720	51.5°	42.30″	175
Clackamas	623,360	51.6°	44.03″	190
Lane (Eugene Area only)	830,720	52.2°	38.23″	197
Linn	977,920	52.3°	42.79″	205
Marion	542,080	52.7°	69.80″	212
Polk	476,160	51.3°	39.89″	173
Washington	487,840	51.1°	48.74″	145
Yamhill	445,440	51.8°	45.78″	174
	4,798,240			

Taken from county surveys of the U. S. Dept. of Agriculture.

The area shown in the above table is not all tillable land suited to farming, with the exception of the figure for the Eugene Area (Lane County). However, most of the state's best land suitable for flax growing is within these counties.

The best soils for flax are those that retain their moisture rather late into the growing season. The most successful are those that are medium to slightly

This type of soil is derived from recent basaltic alluvial deposits so the profile or topography has undergone only slight change. It usually occurs as smooth or slightly undulating land. Some of this bottom land needs protection against erosion by dikes, or the planting of small trees bordering the stream-beds. This will not only prevent loss of land during high water but

will add further deposits of silt, building up the land.

The texture of the Chehalis soil varies from fine sandy loam to silty clay loam and is very productive for the basic crops. The yield on certain areas has been found to increase as much as 100% by proper irrigation.

Several methods of irrigation are used, including flooding and ditch work on level land, and spray systems on the slightly rolling or undulating land. Water can be obtained at comparatively low cost from surface wells or nearby streams. Irrigation will be desirable for at least a few acres on every farm. The rainfall in most of the counties is sufficient for the major part of the year.

The soils of the Willamette series are rated as second-best in comparison to Chehalis soil, but give a good yield of flax. The eight counties mentioned in Table I have 325,056 acres of Willamette soil. Multnomah County, not included in the table, has 26,112 acres, raising the total of Willamette type soil to 351,168 acres.

Soils of this series occupy the gently rolling lands of the valley, allowing adequate natural drainage. These soils are quite adequately supplied with potassium and phosphorus, with a strong variation in the calcium contained.

The texture of the soils ranges from loam to silty clay loam. Crop rotation greatly increases productiveness of these soils, while experiments with fertiliza-

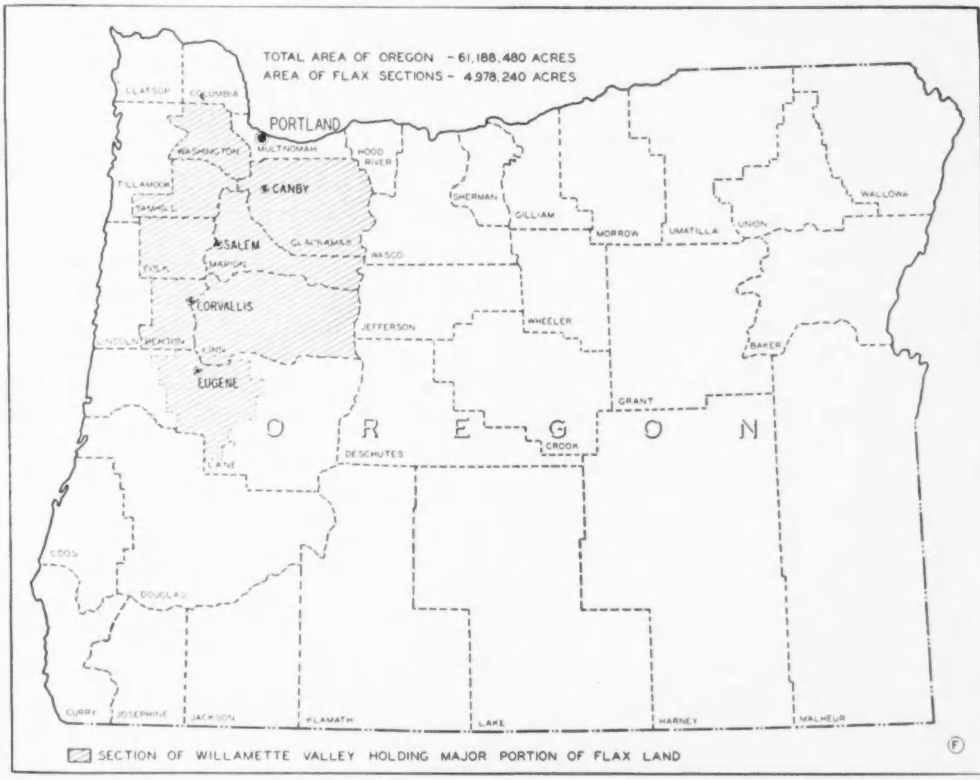

FIGURE 1.—The area shown above represents the general outline of the Willamette Valley in which the major portion of land suited for flax raising is located. The valley is bounded on the east by the Cascade Range, on the west by the Coast Range, and by rolling foothills on the north and south The most suitable flax lands are situated in the approximate center of this area, following in general the course of the Willamette River which rises in the Cascades southeast of Eugene and joins the Columbia River a few miles below Portland.

tion have shown only moderate increases.

Supplemental irrigation greatly increases the productiveness. This is more important with the late season or intensively cultivated crops. Likewise, crop rotation reduces the irrigation costs.

The counties shown in Table I have 198,712 acres of Chehalis and 325,056 acres of the Willamette type, or a total of 523,768 acres suitable for flax growing. 26,112 acres of Willamette type soil present in Multnomah County (not shown in Table I) raises this total to 549,880 acres. To plant this area in flax would increase by 26% the acreage devoted to flax production by the nation in 1932.

The following table shows the distribution of first- and second-rate soils in the nine counties of the Willamette Valley:

TABLE II

County	*Acres of Chehalis Soil*	*Acres of Willamette Soil*
Benton	31,936	14,976
Clackamas	8,704	48,448
Lane (Eugene area)	48,192	35,456
Linn	39,552	34,048
Marion	9,720	76,672
Multnomah	none	26,112
Polk	24,128	13,888
Washington	22,848	65,792
Yamhill	13,632	35,776
	198,712	351,168

Estimated acreage in 1932 by the U. S. Dept. of Agriculture, 2,087,000.

Fiber flax thrives in a cool moist climate characteristic of the Willamette Valley. Excessive heat or drought during the growing season is not conducive to a large yield of fiber flax.

In this valley, moisture in spring and early summer is adequate but rarely excessive. The growing seasons range from 145 to 212 days free from frost. (See Table I.) Nights are cool while day temperatures are equable, with extremes infrequent. A sea breeze in the late afternoon mitigates any tendency toward excessive heat during the summer months. During harvest time—late July and August—there are no rains. Conditions are favorable for the raising of good flax fiber.

According to James E. De Viviere, head of the firm of De Viviere & Co., Coutrai, Belgium, who have manufactured linen successfully for three generations, the flax grown in Oregon is equal to any grown outside the United States. It is well scutched and handled and has a strong fiber with good average spinning quality. In his opinion the flax should spin a warp yarn if handled under proper conditions. (*Oregon Journal*, Portland, Oregon. January 18, 1935.)

Extensive plans are now under way for the raising and milling of flax fiber in Clackamas County near Canby, Oregon. Units are being built for the manufacture of household linens and dress material, for the manufacture of handkerchiefs and finer accessories, and a new phase including the manufacture of linen fire hose, garden hose, and fabric for aircraft.

THE WEST CUMBERLAND COALFIELD

T. H. Bainbridge

THE coalfield extends for 14 miles along the west coast of Cumberland. The coal measure outcrops are between Maryport and Barrowmouth, the latter being on the coast, one and a half miles southwest of Whitehaven, and about the same distance from the North Head of St. Bees. On the average, the coal measures are about five or six miles in width, but at the northern end of the coalfield there is a curious narrow northeastern prolongation about two miles wide and a dozen miles in length (Figure 1). This is due to two lines of faults both of which have a downthrow to the northwest.

The surface area is 90 square miles. But in addition there is a proved area of 12 square miles where the coal measures extend westward beneath the sea, and another 6 square miles where coal is worked beneath Permian strata. Hence the total proved area of the field is 108 square miles.

Geological Characteristics

The general structure of the area follows the tilting consequent upon the uplift of the Cumbrian Dome, so that the succession of rocks coastwards is Older Palaeozoic (such as Skiddaw Slates), carboniferous, and new red rocks, and the dip is on the whole west and northwest towards the Solway Firth (Figures 2 and 3). But extensive faulting has taken place and this has fundamentally influenced the coalfield. We have already seen the curious extension northeastwards due to two large faults which have brought the coal measures against red sandstone to the north and carboniferous limestone to the south. The southern limit of the coalfield is also due to a great fault of pre-Permian age which passes under the outliers of that formation without displacing them, and is therefore not visible on the surface.

Besides delimiting the coalfield to the north and south, faulting has accounted for a number of small structural basins, and these have affected the preservation of coal areas, and in some places brought the main seams comparatively near to the surface. Maryport, Workington, and Whitehaven owe their existence and importance to this geological feature, because they are in close proximity to the most important coal-bearing basins. Figure 2 is a section across the coalfield, commencing about a mile north of Maryport and proceeding in a southeasterly direction. It indicates quite clearly what has been called the Dearham Basin and shows how the coal seams have been made accessible.

The well-marked Pica Basin in the southern part of the coalfield, and east of Whitehaven, is seen on Figure 3. It is probable that coal was first worked in these basins because the coal seams actually out-cropped at the surface and the coal was, therefore, easily obtainable. Other basins exist but they are not always so well defined, as being of pre-Permian or Triassic age they have been disturbed by later faulting.

Between the basins there are sometimes areas which are relatively poor in coal, as, for instance, the district south, and especially southeast from Workington. It is clear that this is accounted for by the Distington Dome which consists essentially of carboniferous limestone (Figure 3).

Along the coast from Flimby to Whitehaven the coal measures dip sea-

wards. However, in the north they very soon change and the seams dip up towards the sea bed. As a minimum cover of fifty fathoms has to be left, much coal remains untouched and undersea workings are not common. The dip gradually increases southward and at Whitehaven, undersea working is possible, and indeed common, the Wellington, William, and Haig pits being actually on the seacoast. In this area coal has been mined three and a half miles from the shore, and at the present time is obtained under the sea two and a half miles from the shaft. While the coal may extend further, there is an economic limit which is determined essentially by the cost of haulage from the working face to the shaft.

Thus the coalfield comprises the exposed area, and the undersea area, while in addition there are smaller extensions north and south concealed under a cover of red rocks. Further extensions of the concealed coalfield are possible towards the north, under the Solway Plain, but

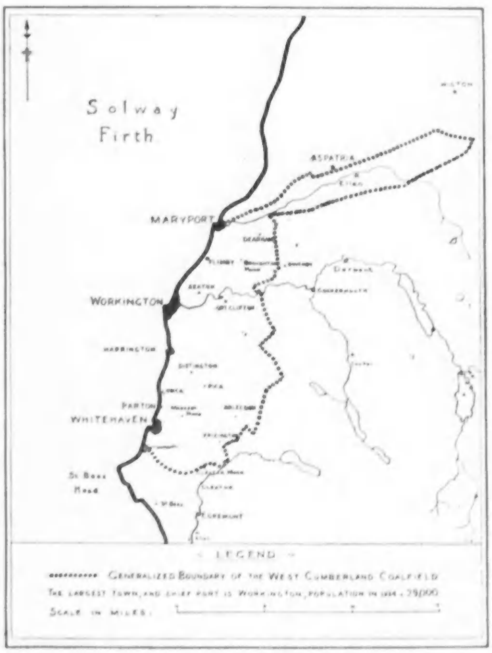

FIGURE 1.—The West Cumberland coalfield.

they are at present merely a subject for geological speculation, and as the depth would be great, probably 3,000 feet or more, the working of such an area is highly improbable.

INFLUENCE OF GEOLOGICAL STRUCTURE ON THE DEVELOPMENT OF MINING

The fact that the coal measures are disposed in a number of structural basins has already been mentioned. Consequently the chief colliery groups are around Whitehaven, Workington, and Maryport, and these three ports owe much of their importance to the geological nature of the coalfield.

Variations in the thickness of seams is a common feature and is a great handicap in coal-mining, especially when even the chief seam shows large variations. The "Main Band" is 5 feet thick at the northern end of the field, and at Whitehaven it is 11 or 12 feet, but in most districts between these two points (e.g. in the Maryport area) it is found in two separate seams with varying distances between them, of from 18 inches to 30 feet, while in the eastern part of the field it is "thrown out" altogether. This feature, occurring in the chief seam, is also typical of the others, and tends to make mining more difficult than if the seams were uniform throughout their courses.

Perhaps one of the worst features of the area is the very extensive faulting which has taken place. There are two main sets of faults, the dominant set appears to be in a N.W. to W.S.W. direction, and the others are N.E. to E.N.E. They range in size from minor fractures with dislocations of a foot or so, to faults having throws of 750 feet. The most disastrous feature of the faulting is the fact that over an area of about thirty square miles, i.e. about one-third of the coalfield, the main band is absent.

Sandstone roofs over some of the

seams have conduced to "nips" or "wash-outs" which vary from a few yards to hundreds of yards. Partings are common, and "riders" or narrow sandstone dykes occasionally cross the coal measures, and in some places the disturbances have been so great that the beds actually roll about. In fact, it is quite common to find on the coalfield, walls built of coal measure sandstones, the individual blocks of which show strikingly contorted laminae. It is reported that in 1818 Mr. J. C. Curwen spent £50,000 in search of the main band, but the search was in vain, for the seam had been entirely "nipped out" in the region explored.

mechanical aids are introduced. Thus in 1930 only 15% of the Cumberland coal output was cut by machinery while the average for Great Britain was 31%.

The coastal nature of the coal measures has been highly advantageous in so far as the export trade is concerned, but it has had the disadvantage that some mines have had to be abandoned because of water "breaking in"—such are the Annie pit at Workington, and the Watergate Colliery near Maryport.

Because of the volatile nature of the coal much gas accumulates near the actual coal face, and in some of the collieries where coal cutting machinery is used compressed air has to be sent along

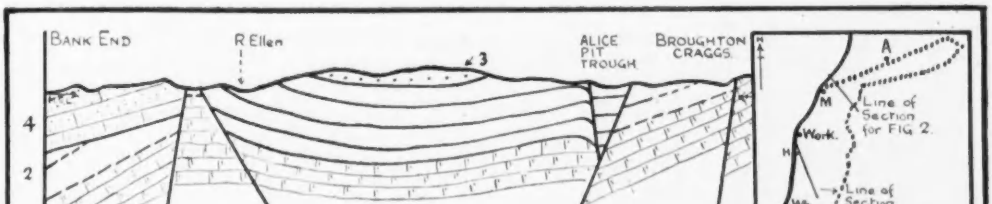

Figure 2.—A geological section of the northern part of the West Cumberland coalfield (After the Geological Survey). (1) Carboniferous Limestone; (2) Coal Measures; (3) Whitehaven Sandstone; (4) St. Bees (red) Sandstone.

The variation in the thickness of the seams and their highly fractured nature have much to do with the fact that the West Cumberland coalfield is a "high-cost" area. The faults, and "nips" considerably interfere with the working of the seams, and cause a loss of output per person employed, owing to the fact that a considerable number of men have to be constantly at work crossing faults and "nips." These faults alter the grades, and so cause haulage difficulties not met with in other coalfields.

Also, the use of machinery is obviously made much more difficult, for example the roofs of the majority of the seams do not lend themselves to that regularity of treatment which is necessary when

the face of the coal to clear away the gas. Several explosions have taken place. For instance, between 1817 and 1824 there occurred at the William Pit, Whitehaven, an explosion which resulted in the loss of 33 lives including a number of women. Much more recently, in 1931, 27 men were killed and 14 injured, by an explosion in the Haig Pit, at Kells, near Whitehaven.

There is one important advantage possessed by the coalfield, however. Owing to the arrangement of the strata, and especially due to the coal basins, the seams are not at a relatively great depth. Indeed, as already remarked, coal outcrops on the surface probably provided the earliest sources of coal. The deep-

est shaft in Cumberland is 1,320 feet, while the maximum depth of any of the workings is 1,575 feet, which is only 37 feet greater than the maximum workings in Cumberland iron ore mines. That the collieries of Cumberland are relatively shallow is made quite evident when it is mentioned that the main shaft at the Parsonage Pit of the Wigan Coal Corporation is 998 yards deep (1,008 to the sump). At the Pendleton Colliery the Rams seam has been worked at about 3,600 feet from the surface, and at Harworth and Thorne in South Yorkshire the shafts are respectively 966 and 963 yards in depth, or more than twice the depth of the deepest shaft in West Cumberland.

compared with such coals as those of Northumberland and Durham. Because of the relatively high ash content coal washing is important in Cumberland, in fact this area is easily first in the whole country for 65% of the coal is thus treated. Cumberland coal is high in volatile matter (30–33% without moisture) and gives an average yield of about 10 to 11 thousand cubic feet of gas per ton. It is very suitable for byproducts of which the yields are high. Hence at the works of the United Coke and Chemicals Company perched on the sea-cliff at Lowca, near Whitehaven, is one of the most modern continuous tar distillation plants in the country.

Coke is now obtainable from the Cumberland coal after screening and washing have taken place, but it is not as good as Durham coke.

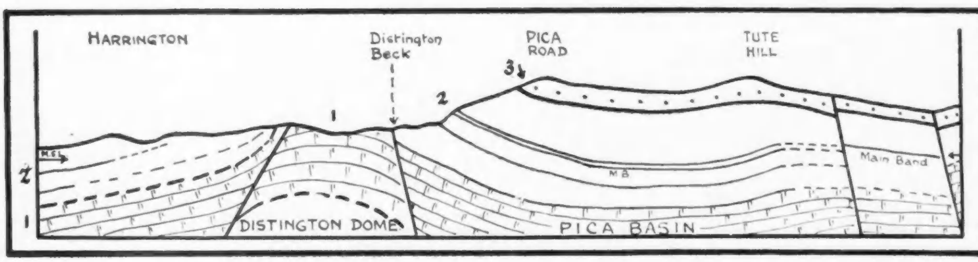

FIGURE 3.—A geological section across the central part of the West Cumberland coalfield (After the Geological Survey). (1) Carboniferous Limestone; (2) Coal Measures; (3) Whitehaven Sandstone. NOTE.—The undulating nature of the coalfield is shown by Figures 2 and 3, while the latter also indicates the sandstone-capped ridge (known in this part as Tute Hill) which forms the maximum elevation of the coalfield, 811 feet.

NATURE OF THE COAL

The coals belong to the ordinary bituminous class suitable for household purposes, gas and coke making, and steam raising (e.g. for locomotives). No anthracite or true steam coals are present. Cannel coal occurs in a few thin seams, and at one time the Dovenby Cannel (a band 9 to 15 inches thick) had a good reputation and brought twice the price of ordinary coal. With the advent of gas mantles the demand for cannel gradually declined.

The carbon percentage is quite normal, but the ash content is high when

The nature of the coal can best be summarized by saying that Cumberland coal is a good general purpose fuel.

THE BEGINNINGS OF THE COAL TRADE

Working for coal probably commenced at quite an early date owing to the coal outcropping at the surface in various parts of the field. Records, however, only date from the 16th century. Mention is made that about 1567 the copper smelting works at Keswick were supplied with coal from Bolton

Colliery, in the northern part of the coalfield.

It was during the 17th century that the coal trade made very rapid progress, and among the first shipments of coal are some from Workington to Ireland in the year 1604. The Workington district did not make much progress, owing, it is said, to mutual jealousy between the numerous freeholders who worked the pits, and the excessive rents demanded by the lord of the manor. Progress was made, nevertheless, at Whitehaven and, about 1620, Sir Christopher Lowther commenced to work coal for sale and export, and in order to further the latter, he converted the little creek into a harbor by building a small pier. Sir John Lowther, his son, exhibited such skill that by 1680 Whitehaven had a large share in the Dublin coal trade, and the workings were unique because coal was worked under the sea, and at a greater depth than in any other British coalfield.

By this same year (1680) the Fletcher family of Moresby, lords of the manor of Distington, had achieved some success with a colliery, and shipments from Parton came into competition with Whitehaven coal in Dublin. Shortly after this, about 1700, the Curwen family were exploiting the coal seams with enough efficiency to make Workington into a coal port of some importance. It was not until 1750 and later that coal was mined at all extensively in both Harrington and Maryport.

EXPANSION OF THE COAL TRADE

The distribution of collieries in Cumberland at the beginning of the 19th century apparently differed but little from the present day. The inland collieries, however, were being worked on a small and primitive scale, generally supplying only the local demand. Pits near the sea, and especially those in the vicinity of Whitehaven, had made great strides. Their geographical position had been an inestimable advantage, land transport of the coal was unnecessary, and a ready market awaited the coal—Ireland, relatively poor in coal—being conveniently situated for short voyages by 100-ton sailing ships.

The greatest expansion of the coal trade was related to two facts. First, the building of railways made possible the development of the inland part of the coalfield and brought these collieries into competition with those on the coast. This is shown by the fact that while about 1815 the entire produce of the coal mines of Cumberland was approximately 450,000 tons, it had risen to 887,000 tons by the year 1854, when the Maryport and Carlisle Railway had been opened, and also the Whitehaven Junction, and the Workington and Cockermouth lines. Secondly, the growth of the iron industry in West Cumberland is reflected in the expansion of the coal trade. Although the Cumberland coal at that time did not provide a good coke, and much fuel had to be brought from Durham, yet by 1869, 453,150 tons of local coal were needed for the iron works. On the average, during the years 1869 to 1871, 33.7% of the coal produced in Cumberland was required for the iron works of the district. Hence it is not surprising to find that the output of 1854 (887,000 tons of coal) had increased to 1,410,808 tons by 1869 and continued to increase so that before the end of the century over 2,000,000 tons were being obtained annually.

The increase in coal production was accompanied by an increase in the number of employees, the 3,579 of 1854 rising to 6,480 in 1884 and this increase continued, the maximum being in 1924 when 11,957 found employment on the West Cumberland coalfield.

One important feature of the expansion in the coal trade should be pointed out. The Cumberland coalfield did not expand at the same rate as did the coal trade throughout the country generally. This is borne out by J. U. Nef's work, "The Rise of the British Coal Industry, 1932," in which he estimates that the relative production of the Cumberland coalfield at various dates, has been as follows:

	1551–60	*1681–90*	*1781–90*	*1901–1910*
Cumberland output as % of the national output . . .	2%	3%	5%	1%

Although the coalfield had the advantage of an early start, and a coastal position, the variation in the width of the seams, and the extensive faulting, militated against a rapid expansion, such as was possible, for example, in the Yorkshire coalfield where there were thick seams relatively undisturbed.

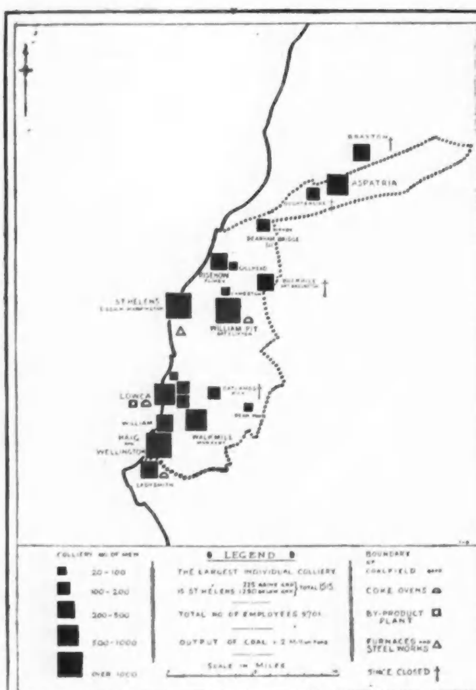

FIGURE 4.—Collieries of the West Cumberland coalfield—1930.

THE COAL TRADE AT PRESENT

Owing to the fact that there was a coal strike in 1931 which lasted for nearly two months, and also because of the abnormal conditions prevailing since that year, it is perhaps better to use, where possible, 1930 statistics.

In 1930 the output of coal in Cumberland was 2,017,969 tons. As this was less than 1% of the output of the United Kingdom, 0.83% to be precise, it is obvious that the West Cumberland is one of the smallest coalfields in the country, when output is considered. Although this output of over two million tons is about equal to the output from the whole of South America, and is about twice the quantity of coal mined annually in New Zealand, this same amount is obtained yearly from two of the Ashington Coal Company's collieries in Northumberland, and from the port of Blyth nearly three times that amount has been shipped in one year.

Twenty-eight collieries were at work in 1930, and three of these were in the Brampton district of East Cumberland. Of those in the western part of the county, 22 employed 10 or more men. The largest colliery was St. Helen's, at Siddick, and within the borough of Workington, where 1,515 found employment. Within the Whitehaven borough 1,471 were employed at the Haig and Wellington pits which are connected underground. The William pit at Great Clifton in the Derwent valley had 1,062 employees, and the four pits at Lowca, owned by the United Steel Company gave employment to 1,215, 924 being connected with the Harrington No. 10 pit. The only place with 500 to 1,000 workers was Aspatria (622). The chief centers of coal-mining in Cumberland are therefore Whitehaven, Lowca, Workington, Great Clifton, and Aspatria, and all these places, with the exception of Workington, are dependent

upon that one industry. The distribution and relative sizes of the collieries can be seen on Figure 4 which shows the coal mines of West Cumberland in 1930.

In 1930, 9,701 persons were employed; 7,528 below ground and 2,173 above ground. Approximately 13% of those employed above ground were females, being the "screen girls" or "pit lasses" who sort out the dross from the coal after screening. They have been employed since pre-war days but are being gradually reduced when, and where, possible. The average number of wage earners per colliery, in 1930, was 346, which is about half of the average number per colliery in Northumberland and Durham, and officials also bear a similar ratio, i.e. 2:1. These facts are an indication of the relatively small nature of many of the mines. In 1930, 98% of the coal was produced by eight undertakings operating 21 mines. Many of the undertakings were either owned or controlled by the iron and steel concerns in the region. The United Steel Companies, Ltd., owned collieries at Lowca, Moresby, and Risehow (Flimby), which employed nearly 30% of the miners of Cumberland. Hence the iron and steel industry and coal mining are very intimately linked.

DISTRIBUTION OF THE OUTPUT

The relative distribution of coal varies from time to time, a greater output meaning also a greater proportion available for export. Fine coal, or small coal, as it is also called, is used chiefly in the local coke ovens (at Whitehaven, Lowca, and Great Clifton; while ovens at Moresby have been reopened), very little of this is exported when the iron works are busy. The figures for dirt vary from one colliery to another, but in Figure 5, showing conditions about 1930, the county average is given.

FIGURE 5.—Diagram showing the distribution of the pit top raisings in West Cumberland.

It is quite clear that the local works form the chief market, 42%. The local works really means the United Steel Companies plant at Workington, where iron and steel are produced. Hence any fluctuations in the iron and steel trade affect the coal industry. Of the coal required for industrial purposes about two-thirds is needed for the manufacture of coke for use in the local furnaces, situated at Workington.

Next in importance is the export trade. It has been already noticed that the coal trade owed its growth to the convenient Irish market, and 30% of the coal of Cumberland is still exported to that country. The coastal nature of the coalfield, together with the fact that the average distance from pit to port is less than three miles and never more than ten, are important geographical features largely determining the trade. In June 1927 the Prince of Wales Dock was opened at Workington, making it the chief port of West Cumberland, with Whitehaven next in importance, while the trade at Maryport has declined greatly. Workington coal exports are chiefly to Ulster (Belfast, Londonderry, etc.) for industrial and household pur-

poses, and Whitehaven trades chiefly with the Irish Free State (Dublin, etc.). Before leaving the Irish trade, one interesting feature may be mentioned. In times of drought (e.g. 1934) abundant supplies of peat are available in Ireland and this fuel then enters into sharp competition with Cumberland coal, thus leading to reduced shipments from the trinity of West Cumberland ports.

The local market for household coal is small, only 12%, about half the national average, being needed to supply domestic users. This market could never be exceedingly large owing to the relatively small population of West Cumberland, and indeed of Cumbria itself (434,000). However, the fact that the coalfield is a "high cost" one means that competition from other coalfields is met with, not only in Cumberland but almost on the coalfield itself. Even in Cockermouth some 15% of the coal sold is brought by rail from other and more distant coalfields, while at Millom in the south of the county only 20% is obtained from the local coalfield, the remaining 80% being obtained chiefly from Yorkshire.

CONCLUSION

The coalfield which is one of the oldest and smallest in the country owed its development to the coastal position and the proximity of Ireland, although in recent years the export trade has suffered from the competition of other coalfields (notably the Ayrshire coalfield) and from the imposition of a Free State tariff on British coal. Lacking as it does a large hinterland and being in an area of few industries, coal mining is therefore closely related to the iron and steel trade at Workington. Any variations in the latter industry have distinct repercussions in the coalfield and so much are we "bound in the bundle of life" that a quickening of the shipbuilding industry on the Clyde creates a greater demand for Workington pig iron which in turn leads to an increased output of Cumberland coal. Thus, though small, this coalfield has still its part to play in the national economy and is of outstanding importance in the lives of the people of Northwestern England. Without it industry dependent upon its production could not satisfactorily continue.

SCRAP IRON AND STEEL INDUSTRY

Albert S. Carlson and Charles B. Gow

MUCH has been written about the steel industry. Little has been said about the scrap iron and steel industry. However, it supplies approximately one-half of the raw material of the steel industry. It thus ranks with pig iron as an immediate source of our steel products. In 1929, 3,447 establishments using 41,462,214 tons of pig iron required 39,120,989 tons of scrap metal in order to fulfill their orders. The value of the scrap amounted to $540,576,509 and the industry employed 150,000 men (Table II). The great importance of scrap to the steel industries lies in the possibilities of producing steel at a lower cost, as well as producing a higher grade of steel at greater speed, than can be done with pig iron. That the steel industry has taken advantage of these facts may be seen by the increasing growth of the use of scrap for the period 1919–1933 as shown by the ratio of Lake Superior iron ore consumed for every ton of iron and steel (merchant iron, plus steel ingots and castings) made in the United States. The ratio was 1.19 in 1919, 0.72 in 1933 (Table I). Ore producers attribute the reduction to the increased use of scrap. The scrap iron and steel industry is a fundamental part of our industrial structure.

TABLE I

RATIO OF LAKE SUPERIOR IRON ORE CONSUMED TO IRON AND STEEL MADE IN THE U. S., 1919–1933

Year	*Lake Ore Consumed (Tons)*	*Ratio of Ore to Iron and Steel*
1919	48,905,969	1.19
1925	54,767,112	1.03
1929	63,666,346	0.99
1931	24,114,753	0.82
1932	10,283,520	0.68
1933	18,115,760	0.72

Scrap metal originates wherever iron and steel are used. However, in order to make its collection profitable, the article must have the size and quality that will permit a price high enough to cover the costs of handling, sorting and transportation. Tin cans, hairpins, nails, and razor blades can not be handled at a profit. There are two major classes of commercial scrap. "Home scrap," constituting fifty per cent of the present scrap volume, includes the croppings, spillings, and clippings of the industries making steel. "Market scrap" makes up the remaining fifty per cent of the supply. It consists of scrap from railroads, automobiles, buildings, etc., as shown in Table II. Market scrap that originates in the rural districts is usually known to the trade as "country scrap." This source is relatively unimportant when considered at any particular time, but, over a period of years, it amounts to a substantial volume. The supply of country scrap is very uncertain. In times of high prices it flows freely, but in periods of low prices the volume falls off rapidly and, in some cases, ceases entirely. It might be considered as a marginal supply.

Home scrap, the most important single source, is collected in volume in the factories where it originates, returned to the furnaces and remelted for further use. Of course, no sorting or rehandling is necessary because of its large volume and uniform quality. It is merely shoveled up and returned to the furnaces in push-carts or belt conveyors.

The supply of this scrap available varies with the type of steel making process used. The Bessemer process results in the plant making more scrap than it can use, while under the open hearth process the plant needs far more

TABLE II
BIENNIAL CENSUS OF MANUFACTURES: 1929

Consumption of Pig Iron, Scrap Iron, and Scrap Steel by Principal Consuming Industries

(An unsuccessful attempt was made to collect data in regard to consumption of pig iron, scrap iron, and scrap steel from manufacturers of motor vehicles. No attempt was made to collect such data from railroad repair shops.)

Industry	*Number of Establishments*	*Pig Iron*		*Scrap Iron and Scrap Steel*	
		Tons (2,240 lbs.)	*Cost*	*Tons (2,240 lbs.)*	*Cost*
Total	3,447[1]	41,462,214	$677,861,682	39,120,989	$540,576,509
Agricultural implements	94	211,945	4,403,171	92,791	1,308,405
Blast furnaces	82	....	....	5,673,176[2]	32,744,377[2]
Cars, electric and steam railroad	15	47,894	1,050,080	265,949	3,666,332
Cast-iron pipe and fittings	74	1,424,837	23,714,570	217,262	3,033,925
Engines, turbines, tractors, and water wheels	58	291,751	6,204,655	179,538	2,733,989
Foundries, not elsewhere classified	2,284	3,465,824	68,974,773	2,834,505	40,240,358
Locomotives	10	21,404	418,539	6,025	95,318
Machine tools	39	65,093	1,351,646	40,512	654,263
Plumbers' porcelain enameled ware (enameled iron)	37	235,711	4,445,167	36,260	513,516
Pumps and pumping equipment	53	64,606	1,318,915	29,270	464,975
Ship and boat building, steel and wooden	20	5,429	118,658	1,568	19,405
Steam fittings and steam and hot-water heating apparatus	80	536,397	10,542,338	280,687	4,228,370
Steel works and rolling mills[3]	372	34,687,157	547,280,159	29,356,522[4]	449,354,754
Stoves and ranges	199	337,762	6,601,380	86,185	1,230,857
Textile machinery and parts	30	66,404	1,437,631	20,739	287,665

[1] The figures in this column represent the numbers of establishments reporting the consumption of pig iron, scrap iron, or scrap steel, not the numbers of establishments classified for census purposes in the industries listed. (The total number of establishments classified in some of these industries are considerably larger, but many of them do not consume pig iron, scrap iron, or scrap steel.)

[2] Some establishments included data for cinder, scale, sinter and open-hearth and Bessemer slag scrap; average cost per ton is therefore smaller for the blast furnace industry than for others.

[3] Includes data for a steel plant operated by an important manufacturer of motor vehicles.

[4] Includes 13,988,399 tons produced and reworked in the same plants, and 958,170 tons which were transferred to other plants in the same industry under the same ownership.

scrap than it produces. In 1890 the open hearth process accounted for 11% of the total steel output in the United States and the Bessemer 87%. By 1930 these percentages had been reversed (Table III). Up to 1915 the year's fresh supply of scrap was about equal to the year's demand but, with the further ascendency of the open hearth process, there has been an increased demand by the steel industry for supplies of old scrap.

TABLE III
PERCENTAGE OF TOTAL STEEL PRODUCED BY OPEN HEARTH FURNACE

Year	*Per Cent*
1890	11
1900	30
1910	61
1920	78
1930	86

Inasmuch as home scrap never leaves the plant of origin no special organization is required for handling it and, consequently, we will say no more about it though it accounts for 50% of the total supply of scrap.

The railroad industry of the United States produces about 16% of the market scrap. This is the material remaining after the railroads have salvaged all the metal that they can use in its original form or after reworking it. In the salvaging yards of the larger railroads rails are frequently re-rolled, hammers made from locomotive tires, washers punched from old boiler tubes, and crowbars made from branch line rails. Much equipment is likely to be retired during the period of railroad coördination now in progress. However, since railroad economy requires the carrying of more traffic with less equipment, the importance of railroads as a source of market scrap will decrease in the future.

The automobile industry, a growing source of supply, contributes 16% of the market scrap. The low prices and the rapid changes in style cause the average life of the American automobile to be six and one-half years. This affords a large amount of scrap. Also, increas-

ing attention is being given to the old automobile as a source of scrap by the manufacturers and this will further augment the supply in the future. The remaining 23% of scrap is reclaimed from buildings, construction equipment, mining machinery, agricultural apparatus, and various miscellaneous sources. The total supply of scrap will be increased in the future from these industries as well as new sources that are constantly being added to the scrap metal list.

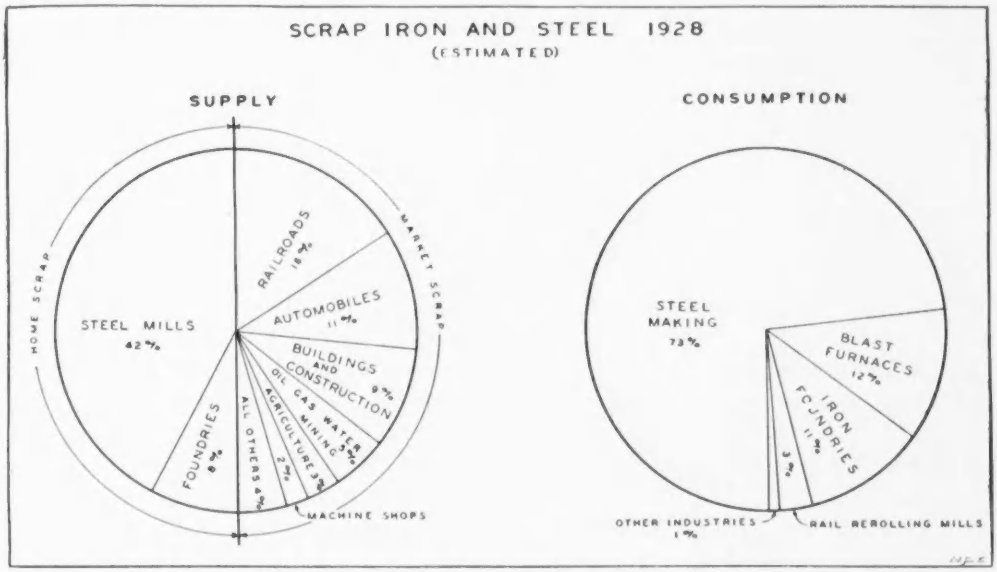

FIGURE 1.—Home scrap is the largest single source of scrap metal and the steel industry the greatest consumer.

The leading states in the use of scrap iron and steel are Pennsylvania, Ohio, Indiana, Illinois, New York, West Virginia, Alabama, and Michigan (Figure 4). The complex nature of the scrap market may be indicated by the large number of different kinds of scrap with regularly listed prices as found on page 67 of the magazine *Steel* for November 25, 1935. The kinds of scrap listed follow: heavy melting steel; compressed sheets; bundled sheets; sheet clippings; steel rails, short; steel rails, scrap; stone plate; couplers; angle bars, steel; low phosphorus scrap; frogs; switches; railroad wrought; machine turnings; cast iron borings; railroad grate bars; forge scrap; axle turnings; steel car axles; car wheels; rails for rolling and cover; low phosphorus punchings. On the basis of net sales, the leading scrap markets are found in the cities of Chicago, Pittsburgh, Youngstown, Cleveland, New York, Reading and Philadelphia (Figure 8). The importance of iron and steel manufacturing centers and of areas of dense population as the source of the scrap iron supply is obvious.

The consumption of scrap iron and steel and of pig iron by states naturally would be quite similar. It is worth noting that the less important the steel industry is in a state the more important scrap iron becomes in the steel industry of that state (Table II). Figure 5, showing the prices for heavy melting scrap, illustrates the large number of separate scrap markets.

The total consumption of home and market scrap amounted to 34,000,000 tons in 1928. Steel making consumed

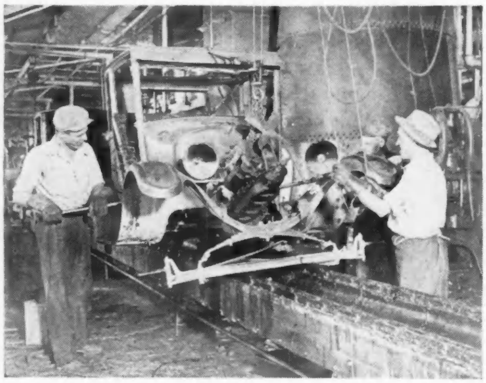

FIGURE 2.—The Ford Motor Company is the pioneer among the motor companies in the use of large-scale plants for the recovery of scrap metal from discarded automobiles. The motor, having a different metal than that in the body, must be removed from the car and melted in a separate process.

73% of the total, blast furnaces 12%, iron foundries 11%, rail re-rolling mills 3%, others 1%. Further details are shown in Table II. The scrap industry has attained this size only after many years of development.

The scrap iron and steel industry is as old as the parent industries. In ancient times bits of scrap metal were frequently used as money. The economizing of scrap began in the United States with the founding of the colonies. This was made necessary by the high price of iron in the colonies due to the high world price plus the great expense of transporting this bulky and heavy metal on the small ships of the time. So precious was iron considered during early colonial days that Massachusetts enacted a law forbidding its export from the state. The village blacksmith's shop helped to turn pieces of scrap into useful articles. The scrap industry was also of domestic significance at the time. It was not unusual for an individual to spend his winter evenings hammering out nails, pots, kettles, and various tools from scrap metal.

The year 1856 may be considered as the date of the birth of the modern scrap iron and steel industry. Until this date the scrap industry was of local significance only. However, the invention of the Bessemer steel process, making iron products in existence distinctly inferior in quality, brought the world its first obsolescence wave. The new metal, possessing superior advantages in strength, elasticity, and durability, rapidly replaced existing rails, tools, and metal hardware. The Civil War further increased the demand for iron and steel products. The resultant high price for scrap gave added impetus to the young industry. From the war period to 1912 the amount of scrap used increased slowly but steadily. The new steel industries depended chiefly on pig iron for its raw material as obsolescence had not occurred to any great extent up to that time.

Technological improvement was a distinct characteristic of the period after 1912 and, as the figures show, a large supply of scrap became available. In 1913 the steel production in the world was 75,000,000 tons, only 3,000,000 tons below the total pig iron production. In 1929 the world produced 118,000,000 tons of steel and 96,400,000 tons of pig iron. It was estimated that about one-half of this total steel production came from scrap. During the twenty-year period, 1909–1929, the production of scrap increased from 7,500,000 to 39,000,000 tons, or an increase of over 400%. This large increase was due to the enormous amount of obsolescent machinery available as well as to the discovery of the Siemens-Martin process for the manufacture of steel.

The last few years mark another period of unusually rapid growth in the use of scrap in the iron and steel industry. All steel plants today, whether in the manufacture of steel or pig iron, use some scrap metal. For the total output of steel in the United States in 1933, the

ratio of scrap to pig iron was 60 to 40. Steel plants operating electric furnaces are the only ones using 100% scrap. Scrap makes as high quality steel and, in some instances, even a higher quality than can be manufactured by the exclusive use of pig iron. The use of scrap also speeds up the time required for manufacture. The amount of scrap used in particular plants varies with the type of product to be made, the cost of scrap in the particular district, the quantity available, the rush order demand, or the distance from ore deposits.

The scrap iron and steel industry is composed of the local rural dealer, the city dealer, the wholesaler and large railroad and automobile companies that have their own salvaging plants. The local dealer collects waste material from factories, building wreckers, homes, or dumps, and dismantles machinery and automobiles. This dealer makes a rough classification before shipping to the wholesaler. The country dealer usually sorts his scrap metal into four rough classes: iron, steel, cast iron, and stove plate. He may deliver his material by the truck load if conveniently located to a wholesaler's yard, as he accumulates it, or otherwise may wait until he collects a sufficient amount to send it by railroad car. The country dealer usually plans to hold his scrap until prices are high and the material can bear the cost of transportation to the wholesale market. The city dealer usually ships regardless of price since his storage is relatively expensive and he must constantly maintain room for sorting, selling used parts, and storing automobiles and machinery not yet converted into scrap.

When the material arrives at the yard of the wholesaler, whether by truck or car, it is dumped into piles and immediately sorted by crews of men trained for the purpose. Frequently the sorting is made into semi-circular pieces of boiler plate open at one end to permit dumping. When one of these containers is full it is picked up by a derrick or crane and it is emptied into the waiting freight car that is being filled with that type of material. The most common grades of scrap fall into the heavy melting metal classification. The increasing use of alloy steel will require more careful grading and a more complex classification. Some of the material the wholesaler must break up. Therefore, the average wholesale plant, in addition to a railroad siding and two or three large derricks or cranes, contains acetylene torches, shears, and a "skull cracker." The latter tool is a heavy steel ball that may be raised by a derrick and dropped upon the casting or machinery to be broken up. The yard usually has a power plant for operating the derricks and the shears. Most wholesalers plan to ship as much as 90% of their incoming scrap on the day it is received as their profits depend on the quick turnover of a large volume.

The larger railroads, freight car salvage companies, and ship wrecking companies require much additional equipment as, for example, electric cranes, crushers, baling machines, compressed

FIGURE 3.—Automobiles provide 11% of the market scrap metal supply. These cars are waiting to be stripped of their non-metallic parts before being crushed and melted at the Ford Plant, Dearborn, Michigan.

air hammers, electric magnets, acetylene generating plants and a pipe line system to carry the latter material to various parts of the yard. Some local scrap dealers require special machinery of the above type because they specialize in certain types of material. For example, concerns handling factory shavings utilize briquetting machines and magnetic separators for extracting the ferrous from the non-ferrous metals.

Henry Ford has been a leader in large-scale salvaging. His first major salvaging job included the demolition of 199 government vessels. At present he maintains an automobile reclamation plant at River Rouge. Mr. Ford's methods foreshadow the future large-scale salvaging plant. The reclamation plant contains a regular assembly line of the endless chain-belt type similar to that used in the assembling of automobiles. Cars are run down this line with each man performing some particular operation of demolition. As the car progresses it is gradually torn apart until only the wheels, frame and body remain. This portion is then crushed in a powerful baling machine and made into

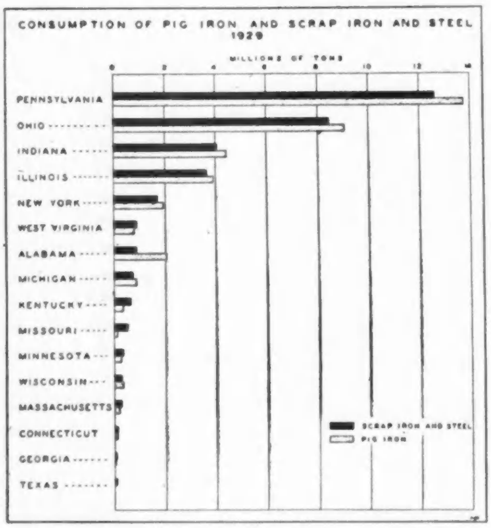

FIGURE 4.—Scrap is practically as important a raw material as pig iron in our leading steel producing states except Alabama.

neat bundles for the furnaces. Over four hundred cars can be baled in an eight-hour day. Every bit of the car is put to some useful purpose.

At times the scrap industry results in several associated types of salvaging. Automobile wreckers in the large cities often salvage the cars for the steel and collect the glass, copper, lead, babbitt, and aluminum as a side line. In the country the opposite is often true and the collection of scrap iron becomes a secondary object. The auto parts business operates in a similar manner. Direct re-manufacture, in which case the scrap is not melted down but stamped or re-rolled into new articles, consumes a good deal of scrap. The Italian government re-rolls all old car axles; the Simmons Hardware Company makes axles into bed metal; and the Murray Body Company, manufacturers of automobile bodies, makes metal toys during the slack season from their sheet scrap.

We have already indicated that over 50% of the scrap metal never leaves its place of origin. The economics of home scrap is, therefore, that of the particular plant where it originates. These plants are too diverse and scattered to be treated here. The economic characteristics of the local rural dealer, the city dealer, and the wholesaler are much alike though differing in degree and, in general, will be considered together in the following pages.

The plants of the scrap dealers increase in size from the relatively small one of the rural dealer to the larger one of the wholesaler, with plants like Henry Ford's the largest of all. A corresponding increase in capital is required. In general, however, the capital outlay required for land, buildings, and plant is comparatively small. A large amount of money changes hands in the course of a year in the industry, but little cash is tied up for any length of time since the

cash turn-over for purchase and sale is unusually rapid. Once the scrap metal is loaded it moves rapidly to its destination. Frequently a sale is made before the material is actually assembled.

Specialty dealers, such as Ford, necessarily have a large capital investment. Such concerns are, however, of a decided minority; yet, due to the comparatively large volume of business which they handle, they are a most important factor. On the other hand, the capital outlay of the small dealer depends upon the number of separate functions that he attempts to perform. If he confines himself merely to wrecking old automobiles, he requires only sledge hammers, chisels and wrenches, and consequently less capital.

There has always been an excess of capital in the scrap metal business. The limited amount of capital initially required, the chance of large profits occasionally, and the fact that one may be one's own boss, have all been factors that have contributed to this large amount of ready capital in the industry.

No particular skill is required in the sorting, handling, and loading of scrap. The amount of wages paid to the individual worker in the industry is low, although the total amount of money paid to labor is fairly large.

Management is an important function in an industry composed of small units competing sharply against one another under fairly sudden price fluctuations. Only the most efficient operators can survive. The dealer must know his market, he must know which kind of scrap gives the best results for the buyer, he must be familiar with the various grades of scrap and their market supply, demand, and price. The characteristics required of the successful manager by the industry seem to have been found among the Russian Jews. They are the dominant race in the industry and they

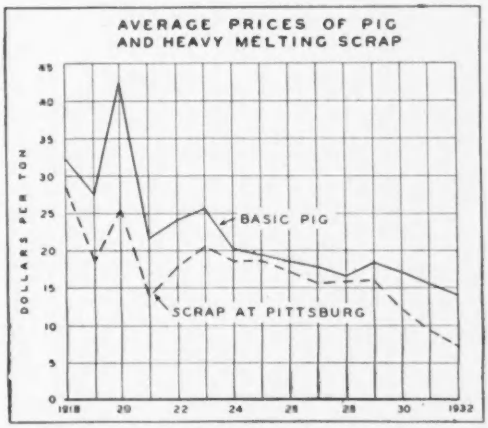

FIGURE 5.—The use of scrap often offers definite technical benefits to the producer. A further advantage is gained when the prices for scrap are lower than for pig iron. The divergence in prices after 1929 encouraged a relative increase in scrap consumption.

are found in all phases of it, from the familiar "junk man" with the thin horse and rickety wagon, to the owner of a large wholesale yard.

The ability to gauge the future prices of scrap accurately has become a less necessary faculty on the part of the manager since 1929 because a better organized market prevents sudden fluctuations in price. The graph indicates that the price of scrap was downward from 1918 to 1924, and then showed improvement until 1930, when it dropped again. The much lower price for scrap than for pig iron since 1930 indicates one of the reasons for increased popularity of scrap iron. The manufacturer will buy scrap at any time that it is available in quantity and at a cheap price. The greater decline in the price of scrap metal than of pig iron is due to the more competitive market in which the scrap dealer operates, plus the added fact that he works with a more rapid turnover of stock and smaller storage space.

The supply of scrap is subject to frequent fluctuations because of the hand-to-mouth nature of the industries. When prices rise country scrap comes into the market, and the supply is soon

replenished and the prices drop. Also, a high price encourages the increased use of pig iron with a consequent lowering of demand and a fall in price. When scrap prices fall there is an increase in demand for it at the expense of the pig iron market and the supply of scrap is absorbed and a readjustment in price occurs. These forces have worked out in the past in such a way that there has been a difference of only a few dollars in scrap and pig iron prices. At present the low price of scrap has encouraged the steel industry to use large amounts of scrap. Sharp fluctuations in price levels, and other trade problems, caused the personnel of the industry to organize the "Institute of Scrap Iron and Steel" in 1923.

The formation of the institute provided an agency that could study methods of grading scrap. Correct grading with the necessary careful attention to proper sorting, involves the study of one of the high-cost operations that the scrap man must perform. Railroad scrap iron may be separated into as many as eighty classifications. When care is taken in the sorting a fairly large labor cost is involved. When the sorting is done without care and not according to a uniform method, the buyers and sellers have great difficulty in agreeing upon a price. The result is a poorly organized marketing system, with its high operating costs and a tendency to demoralize the whole industry, followed by dissatisfaction and dickering. A satisfactory grading and classifying system has been put into operation, and ethical practices have been encouraged.

The size of the area from which scrap is delivered to the primary markets of the country varies with the price of the scrap and the distance from the market of the local dealer. Naturally, with such a heavy and bulky commodity as scrap iron, the cost of transportation is an important item in the total cost. In general, the high cost of transporting scrap has limited the profitable collection of it to a distance of 300 miles from its market. During normal times freight rates of over $5.00 per ton cannot be paid in most regions. Cities having the advantage of cheap water transportation may compete successfully at distances greater than 300 miles.

FIGURE 6.—Eastern steel plants (South Works, American Steel and Wire Company, Worcester, Mass.) use large amounts of scrap metal in their open-hearth furnaces. This pile is composed of discarded machinery and railway equipment.

A flow map of the industry would consist of a network of small rivulets from many parts of the country converging into larger streams as they near the large industrial center, the length and thickness of the flow lines changing as the price changes. Until recently the great bulk and relatively low value of scrap with its high transportation costs has kept the exports and imports at a fairly

low figure. From 1925 to 1932 the total exports of scrap amounted to $2,223,000 gross tons.

However, since 1932 the scrap iron industry has become international. The expansionist activities of Japan and Italy, the depressed conditions in the United States, and the 1933 devaluation of the dollar and the consequent exchange rates have combined to make the exporting of scrap a profitable enterprise. In Japan, in the early part of 1933, about 48 yen could buy a ton of steel scrap in Eastern Pennsylvania, whereas in November, 1933, the same 48 yen could purchase close to 1½ tons of similar scrap at the same point. From January 1933 through the first half of 1935 more than 3,750,000 gross tons of scrap have been exported to foreign countries.

Fifty per cent of the export scrap is shipped from Atlantic ports. The New York customs district alone ships about one-half of this total. The remainder flows from the Philadelphia, Virginia, and Florida ports. The Eastern seaboard had large supplies of scrap piled up because of the decrease in the usual demand of the steel industry. The location of these supplies at or near the seaboard, the low price, and the ideal nature of the scrap as cargo for tramp steamers

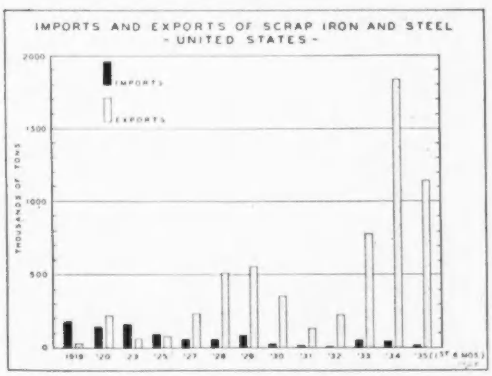

FIGURE 7.—The great jump in exports in the years 1933–1935 was due to the relatively low prices for scrap and to the large increase in demand of Italy and Japan.

bringing bulky supplies from the Orient all combined to encourage its export. The export demand coupled with improved conditions in the steel industry has resulted in a 69% increase in scrap prices in the eastern area from 1932 to the present. In the same period the price of basic pig iron has increased 29% and the composite price of the major finished steel products only 8½%. Steel producers as far inland as Pittsburgh have felt this increase in price.

About one-third of the total supply from Atlantic ports goes to the Orient. Approximately 25% of the scrap from the Gulf Ports is shipped through the Panama Canal and joins the 17% of the total shipped from the Pacific ports and destined for Japan.

Japan is the largest buyer of scrap. From 1925 through 1932 Japan bought an average of 106,000 gross tons of scrap a year. Since then she has bought an average of 976,000 gross tons—an increase of 800%. The low cost of the scrap during these years, its high iron content, and the low content of the iron ore available to her encouraged this large increase. In 1932 Japan could lay down good melting grade scrap at her furnaces for $9.00 or $10.00 per ton. That is, she was paying around $6.00 per ton for the scrap and $3.00 to $4.00 in transportation charges. In spite of higher prices, Japan bought approximately 725,000 gross tons in the first six months of 1935. This is about 78% ahead of her purchases in the corresponding period of 1934.

The United States exported an average of 35,000 gross tons of scrap to Italy from 1925 through 1932. Since 1933 an average of 194,000 gross tons of scrap has been shipped to Italy yearly —an increase of over 450%. In the first half of 1935 exports of scrap to Italy totaled 146,000 gross tons, a 55% increase over the first half of last year.

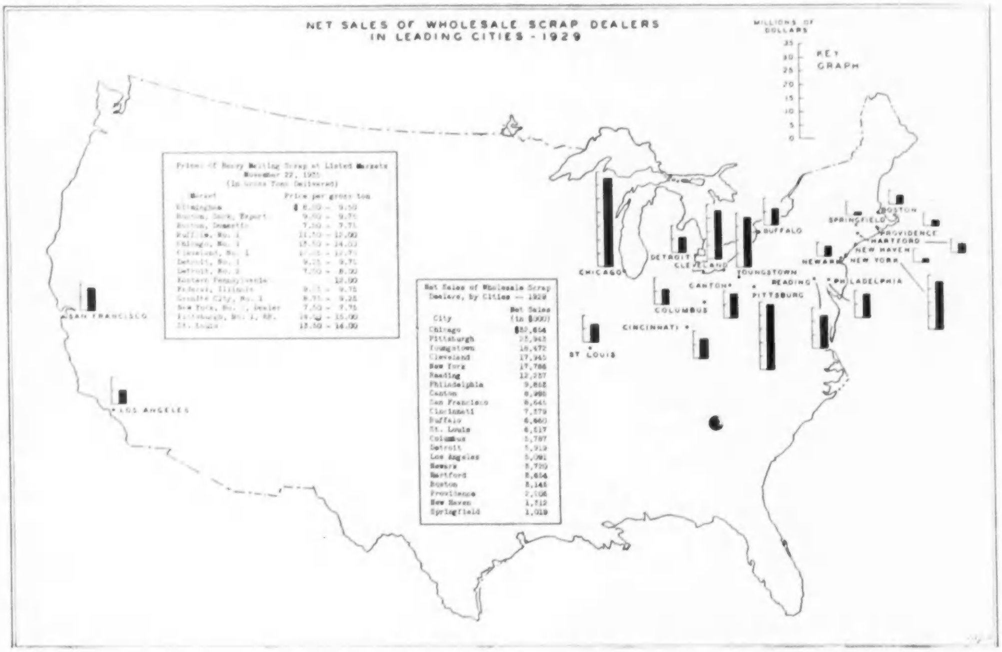

FIGURE 8.—The large markets for scrap are closely associated with the heavy industry centers of the Middle West and with the large population centers of the East Coast. The prices of heavy melting scrap indicate a greater relative demand for scrap in the Great Lakes region than along the Atlantic Seaboard.

The United Kingdom, Canada, Poland, Mexico, and China are other important consumers of scrap from this country. Since 1933 these exports have increased only 2½ times above the average for the period 1925–1932.

Aside from Canada, the United States is the only nation that permits the export of scrap iron. We have not felt the need of prohibiting its export because of our large supply of iron ore available. Nevertheless, the scrap industry is one of our most important agencies for conserving our natural resources. It has been estimated that for each ton of iron and scrap used a total of five tons of iron ore, coal and limestone are saved. On this basis 200,000,000 tons of these materials were conserved in 1929. The possibilities of scrap as a conserver of our natural resources and the great rise in the amount of scrap exported recently has raised a hue and cry from our conservation enthusiasts who regard each shipload as the passing of an irreplaceable natural resource—which it is.

The scrap iron and steel industry foreshadows the development of other industries that will salvage our obsolescent machinery and thereby lower our cost of production and, more important, aid in the conservation of our natural resources.

THE GRAIN TRADE OF THE PORT OF VANCOUVER, BRITISH COLUMBIA

Leah Stevens

THE layout of the port of Vancouver, British Columbia, reflects the chief exports, wheat, lumber, and fish. Forms stretch along the full length of Burrard Inlet from west to east, but are localized chiefly in the western end of the harbor on the southern shore of Burrard Inlet. Piers, wharves, and docks are clustered in the west end of this section of the harbor (Figure 1). Elevators are farther east and one is on the north shore of the inlet (Figure 2). The sawmills are widely scattered along the shores of the inlet and many are clustered on the south shore of False Creek, a shallow arm of the sea just south of the main harbor (Figure 3).

The general volume of export trade of Vancouver has greatly aided in the phenomenal rise of this port to importance, but it is as an outlet for Canadian grain that the port has achieved international importance. Vancouver, the youngest of the established and recognized seaports of the world, is the pioneer on the Pacific Coast of North America in the export of bulk grain.

Present Importance of Vancouver in Canadian Grain Trade

Unlike the lumber export trade at Vancouver, the grain trade of the port has maintained a rather high tonnage even through the period of the depression. The grain trade also differs from the lumber trade in that it is new. Since the first commercial shipments of 500,000 bushels of grain in 1921, the volume has increased to 95.4 million bushels in 1928–1929 and 96.9 million bushels in the 1932–1933 crop year. (Vancouver

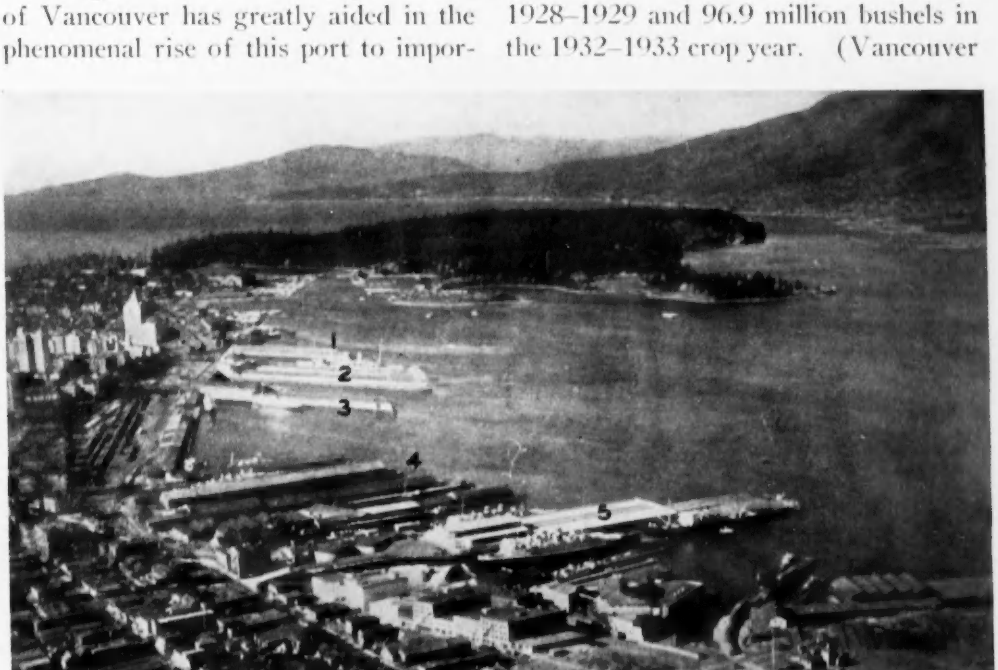

FIGURE 1.—View of the Canadian Pacific piers, looking west toward Stanley Park. No. 1 indicates Pier A, 2 indicates Pier B-C, 3 Pier D, and 4 Pier H. The Canadian National Pier is numbered 5. The wooded area in the near background is Stanley Park. (Copyright by Western Canada Airways, Ltd.)

Merchants' Exchange, Vancouver Grain Shipments Reports, Aug. 1, 1928 and Aug. 1, 1932, p. 1.) Grain made up 73 per cent of the total export tonnage of Vancouver in 1932.

During the crop year ending July 31, 1932, Vancouver and other Pacific ports handled 44 per cent of the total Canadian grain exported, 37 per cent went by Canadian Atlantic Coast ports, and 19 per cent went via United States Atlantic Coast ports (Figure 4). Before Vancouver became an important exporter of grain, the United States ports handled a far greater proportion of the Canadian crop exported abroad. During the 1922–1923 crop year, for example, Vancouver handled only 9 per cent of Canada's wheat exports, Canadian Atlantic ports handled 33 per cent, while United States Atlantic ports handled 57 per cent of the Canadian wheat exports. The Port of Vancouver has diverted considerable of that trade, but has reduced the grain tonnage of eastern Canadian ports relatively little.

Comparison with Montreal.—Vancouver now has first rank as an exporter of Canadian grain, but it seems unlikely that the volume of grain passing through this Pacific port can ever affect Montreal's position as Canada's leading port for all grain exports, and as the greatest grain exporting port on the North-American Continent. In 1927 Montreal shipped 194,435,569 bushels of grain of all kinds, a volume two and one-half times that shipped by the Port of Vancouver, although Vancouver is open twelve months in the year. (*Harbour and Shipping*, XII, June, 1929, p. 252.) The quantity shipped was as much as that from seven leading ports in the United States combined. This is explained by the fact that Montreal's outstanding position in grain traffic rests upon the amount of United States grain which it handles. This United States grain amounted to 47.2 per cent of the total grain exported from Montreal in 1927.

The increasing use of the combine reaper-thresher in western Canada will, doubtless, prove to be an important factor in increasing the amount of grain shipped through eastern ports in both

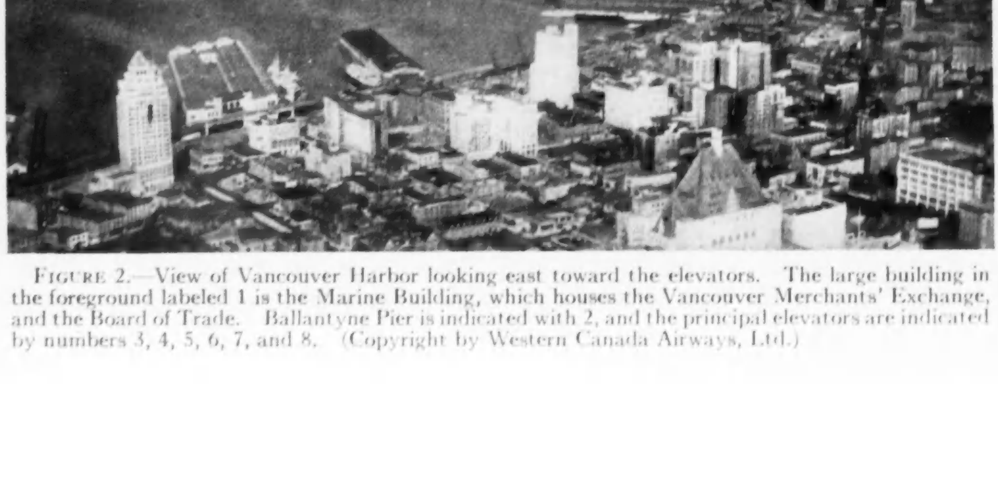

FIGURE 2.—View of Vancouver Harbor looking east toward the elevators. The large building in the foreground labeled 1 is the Marine Building, which houses the Vancouver Merchants' Exchange, and the Board of Trade. Ballantyne Pier is indicated with 2, and the principal elevators are indicated by numbers 3, 4, 5, 6, 7, and 8. (Copyright by Western Canada Airways, Ltd.)

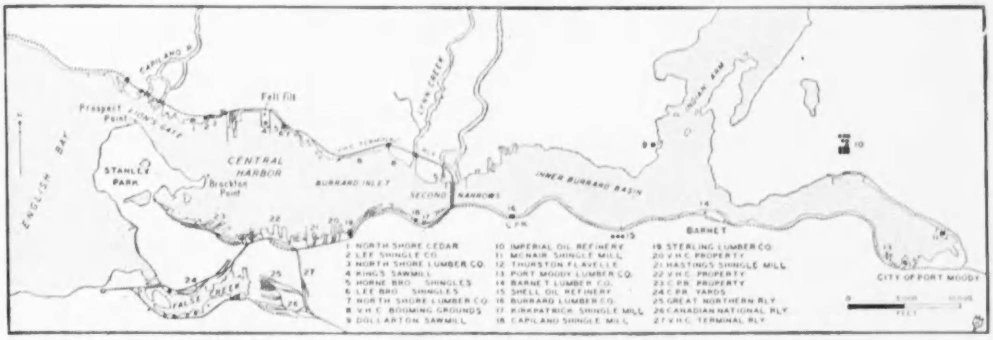

FIGURE 3.—Harbor of Vancouver, showing principal properties and sawmills in black squares. (Based on Vancouver Harbour Commissioners' Annual Map.)

Canada and the United States. Their use eliminates the usual delay between harvesting and threshing. Thus the grain may leave the field by railway as soon as the cutting starts. Railroads may then start moving the year's crop about two weeks earlier than has been the case previously. This will permit a greater proportion of the grain crop to move out of the country before the closing of navigation on the Great Lakes.

The Welland Canal, too, should aid in diverting grain from the Atlantic ports to Montreal. This canal permits the passage of large Lake Superior ships up to twenty-four foot draft carrying grain from Port William and Port Arthur up the St. Lawrence to Prescott, only 115 miles west of Montreal. These large ships are fast and thus they reduce considerably the time formerly taken to get grain from the head of the lakes to Prescott. There cargoes of grain are unloaded and transferred to fourteen-foot draft boats and then taken to the great gulf port. Montreal, therefore, should not be alarmed over the fact that Vancouver now exports the larger proportion of Canadian grain since she may make up for the loss by diverting a part of the 19 per cent of the Canadian grain which passed through United States ports in 1932 (Figure 4).

Comparison with Other Canadian Ports.—The other Canadian ports besides Montreal and Vancouver rank very low in export of grain. In the 1930–1931 crop year period, Vancouver exported 97 per cent of the total Canadian grain shipped from the Pacific Coast. New Westminster, Victoria, and Prince Rupert together shipped only 3 per cent of the total grain sent via the Pacific Coast of Canada. Quebec, Halifax, and St. John combined shipped only 6.17 per cent of the total Canadian grain exported.

TRIBUTARY AREA IN TERMS OF WHEAT

Although the population is increasing slowly in Canada, there is so much grain-growing land as yet uncultivated that the production of grain is increasing more rapidly than the home market demands. As a consequence, each year finds a larger surplus left over for export. Ninety-four per cent of the wheat of Canada is produced in the Prairie Provinces, and a large part of the wheat-producing area of the Prairie Provinces is tributary to Vancouver.

Fluctuation in Tributary Area.—The wheat area tributary to the Pacific ports depends upon the combined rail and water rates to these ports and fluctuates with these rates. Freight rates to Europe via the Panama Canal have been rather low, about 17 s. and 6 d. as com-

pared with a normal rate of 25 s. The result of this has been to shift the dividing line between eastern and western grain routes farther eastward. In midsummer when both lake and ocean rates are low, the territory tributary to Vancouver is quite limited. It then extends only as far east as Calgary and Edmonton in Alberta (Figure 5). But, as autumn comes on, the eastern rate on the lake increases and as a result Vancouver's tributary area enlarges, extending through the whole of Alberta. In winter, when the lake is closed, it sometimes reaches even as far east as Saskatoon, a distance of 1,050 miles (Figure 5). Saskatoon is, however, beyond the reach of the Pacific Coast under ordinary circumstances. In the 1930–1931 crop year, 58 per cent of the crop of Alberta, but only 20 per cent of the total Prairie Province crop, moved through Vancouver (Figure 6). In the 1931–1932 crop year 55 per cent of the Alberta crop and 26 per cent of the crop of all of the Prairie Provinces was exported through Vancouver (Figure 6). During the 1931–1932 crop year 40 per cent of the total wheat produced in the Prairie Provinces was produced by Alberta (Figure 7).

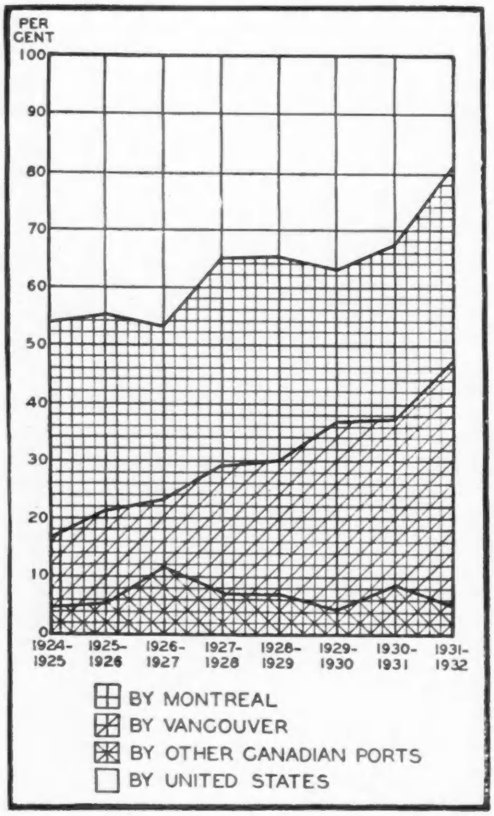

FIGURE 4.—Cumulative graph showing Canadian grain exports in percentages by major ports for 1924 to 1932 inclusive. Percentages for each port are placed upon each other so that they total 100 per cent. (Derived from Dominion of Canada National Ports Survey 1931–1932, by Sir Alexander Gibb, p. 49, and interview with the Vancouver Merchants' Exchange.)

Increased Acreage in Wheat.—The wheat lands in Canada are steadily expanding toward the Pacific. Alberta and British Columbia contain some lands, not now in wheat, but suited to wheat. The Peace River district with its 20,000,000 acres of virgin land suited to wheat has scarcely yet been touched. Most of the wheat exported from this region makes its way through the Port of Vancouver and will continue to do so, no doubt, unless Port Churchill on Hudson Bay proves a success. The short period of the year during which this port is open will, doubtless, hamper its growth.

Water Haul versus Land Haul from Tributary Area.—Movement of grain from Calgary to Liverpool makes a land haul and a water haul; a land haul of 600 miles costs nearly as much as a water haul of 8,500 miles.

"A bushel of grain shipped from Calgary to Vancouver by rail, a distance of about 600 miles costs 15 cents. To carry a bushel of grain from Vancouver to Liverpool, a distance of 8,500 miles, costs approximately 20 cents. It is apparent from this that the cost of carrying one bushel of grain one mile is fully ten times as great by land as by water." (*Annual Report of the Vancouver Harbour Commissioners*, 1922, p. 9.)

The land haul from Calgary to Montreal is more than three times as great as

that from Calgary to Vancouver. The distance from Edmonton to Montreal is almost three times as great as that between Edmonton and Vancouver. This shorter rail haul gives Vancouver the decided advantage over Montreal in the shipment of grain from Calgary and Edmonton. Even Saskatoon and Regina in Saskatchewan are several hundred miles nearer Vancouver than Montreal. The rail haul from Moose Jaw to Montreal is 820 miles as compared with 1,080 miles to Vancouver. This gives Montreal a decided advantage in shipment of grain from this center. With the equalization of westward and eastward grain rates, it would appear that more of the grain from these centers would move through Vancouver.

FIGURE 5.—Fluctuation in the area tributary to the Port of Vancouver in winter and summer. Region shaded in vertical lines is the area from which most of the wheat that enters the port comes, and area shaded in diagonal lines is the region from which occasionally shipments come in winter. (British Columbia Today, 1931, map used as a base, p. 7.)

Routes and Freight Rates

Railroads Carrying Grain.—All of the grain from the Prairie Provinces moving westward to Vancouver moves either by the Canadian Pacific or by the Canadian National railways. Of the grain shipped through the port in 1927–1928, 55 per cent was carried by the Canadian Pacific and 45 per cent by the Canadian National. In the 1929–1930 crop year, two-thirds of the grain was carried by the Canadian Pacific and a third was carried by the Canadian National railways. Of the 93,822,000 bushels of grain shipped to Vancouver from August, 1932 to June 19, 1933, 58 per cent came to Vancouver by the Canadian Pacific and 42 per cent by the Canadian National railways. Because of the distinctive territories served by these lines, when the yield in grain is greater in Southern Alberta than in Northern Alberta, more grain moves by the Canadian Pacific, but when the yield is greater in Northern Alberta, more grain moves to Vancouver via the Canadian National.

Reduction in Rates.—The flow of grain from production centers to the ultimate consumer is often diverted from one route to another by fractional differences in grain rates. "Grain takes what is known as a 'commodity rate' which is very much cheaper than standard freight rates for merchandise." (C. P. Piper, *Principles of the Grain Trade of Western Canada*, Winnipeg: Empire Elevator Co., Ltd., 1915, p. 15.) Because it can be handled in bulk and in quantities and because it constitutes a very large proportion of the tonnage of the railroad, it is given a low rate.

The flow of grain westward following the opening of the Panama Canal was retarded by differences between rail rates eastward and westward. In 1915 there was a wide margin of difference between the rail rates on grain moving eastward and westward. The difference against the Pacific Coast route was from 20 to 31 per cent higher. Even in 1923 it cost 10½ more cents per bushel to move grain 1,200 miles westward in Canada than it did to move it eastward. Between 1921 and 1927 a series of reductions in grain rates per bushel to Vancouver were secured. These reductions amounted in all to eleven cents per bushel. They made it economical to

ship grain from most of Alberta to Vancouver rather than to Montreal. However, the eastern route still has the advantage in shipments of grain from places equi-distant from Vancouver and Montreal.

Because of the continual fluctuation in water rates, no stable set of figures can be presented as a comparison between the cost of transporting Canadian wheat to Europe via the Pacific Coast and via the Atlantic Coast. However, these water rates fluctuate within the following limits:

Vancouver to U. K.	11.6 to 23.6 cts. per bu.
	Canal rates 1½ cts. per bu.
Ft. William to Montreal ..	11 to 14 cts. per bu.
Montreal to U. K.	7 to 8 cts. per bu.
	(Piper, *op. cit.*, p. 15.)

Seasonal Flow.—Since Vancouver is an all-year-round port, while Montreal is closed by ice during the winter months, the greatest amount of grain flows through Vancouver during the winter months. Winter may, therefore, be said to be the harvest time for Vancouver. In the 1930–1931 and 1931–1932 crop years, 41 per cent of the grain moved from the port during the months of November, December, January, and February. In the 1932–1933 crop year, 50 per cent of the grain exported from Vancouver was shipped during these four winter months (Figure 8). The importance of the grain export in autumn and winter is indicated by the increase in deep-sea departures during these months (Figure 9). But some grain is shipped from the port during every month of the year.

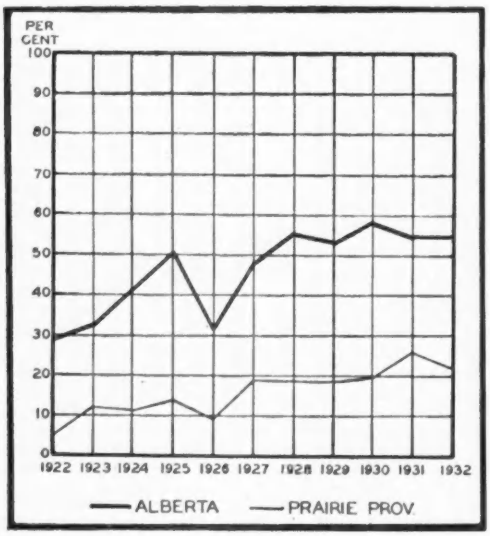

FIGURE 6.—The percentage of Prairie Province and Alberta wheat moving via the Port of Vancouver from 1922 to 1932 inclusive. (*Harbour and Shipping*, XV (Aug. 1932), p. 219; XVI (Aug. 1933), p. 175.)

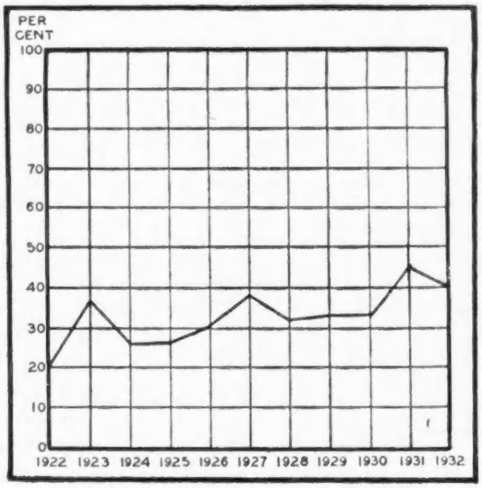

FIGURE 7.—Percentage of Prairie Province wheat produced in Alberta from 1922 to 1932 inclusive. (*Harbour and Shipping*, XV, Aug. 1932, p. 219; XVI, Aug. 1933, p. 175.)

Tramp Vessels vs. Liners.—As a wheat-exporting port Vancouver differs in certain marked respects from Montreal, or from other wheat-exporting ports on the North-American Continent. Grain moves partly in chartered tramp vessels and partly in liners. The proportion carried by each varies according to the quantity of grain to be moved and the amount of space left over for this commodity. Constant availability of grain to fill holds of ships has encouraged a rapid development of the liner trade with Europe and the amount of liner space for grain is increasing from year to year. During the 1928–1929 crop year, liners carried 39 per cent of

the total bulk grain shipped from Vancouver. By the 1929-1930 crop year liners carried 61 per cent of the total bulk grain (Figure 10). Tramps taking part cargo carried 16.2 per cent of the total bulk grain, and tramps taking full cargo carried 22.7 per cent of the total bulk grain (Figure 10). Tramps that take full cargo are not so numerous as tramps carrying part cargo. Therefore, more vessels are required to carry a certain quantity of grain from Vancouver than is the case from Montreal. The number of tramps carrying full cargo has decreased even more during the 1932–1933 crop year. Approximately ten tramps carried full cargoes of bulk grain from Vancouver during the 1932–1933 crop year. "It has been estimated that in the 1932–1933 crop year approximately 60 per cent of the shipments to Europe have been in berthed vessels carrying principally grain, 30 per cent in general cargo liners carrying parcels of grain, and 10 per cent in full cargo vessels chartered by importers." (*Harbour and Shipping Journal*, Vancouver, B. C., XVI, p. 174.)

ELEVATORS

Feeders in Prairies.—In order to insure a constant flow of grain through the terminal elevators in Vancouver, it is necessary to establish feeders, country elevators, in the prairies. Spillers, Alberta Pacific Grain Company, and other big grain interests have established country elevators at Edmonton, Calgary, and other Prairie Province centers. From these centers grain moves to Vancouver. In 1930 Alberta had 1,707 country elevators with a capacity of 64,647,000 bushels.

Location of Elevators.—The elevators, because of the lateness of the development of grain trade in Vancouver, were forced to occupy property in the eastern part of the south shore of Burrard Inlet. The Canadian Pacific had already gained control of the western section of the waterfront. The elevators have the advantage of being in the less congested part of the harbor and of having plenty of room for trackage and elevator layout (Figure 11).

The Alberta Pool No. 1 built as far out of the Central Harbor and west of the Second Narrows as possible in order to get cheaper frontage and plenty of space so that a great amount of switching need not be necessary, and yet the hazard of shipping past Second Narrows was avoided. Cars are pulled in at one end, and out at the other.

The Midland Pacific Elevator on the north shore of the inlet is built on a point of land so that the expense of building a jetty was not necessary. Two vessels may be accommodated at once on the two sides of this point.

The other five elevators were established earlier and are nearer the main piers and docks of the Central Harbor. The Columbia Elevator is the only elevator with its shipping gallery built over the Canadian Pacific right-of-way.

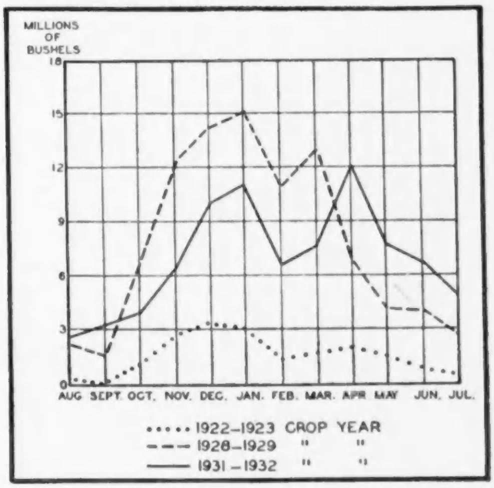

FIGURE 8.—Grain movement from the Port of Vancouver for three crop years. (Vancouver Merchants' Exchange, Vancouver Grain Shipments Reports, Aug. 1, 1928, p. 1, and Aug. 1, 1932.)

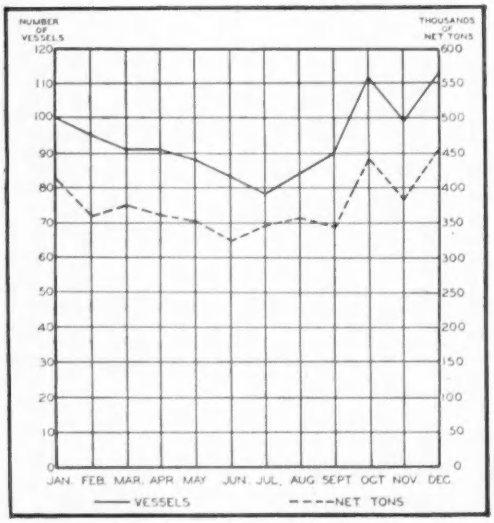

FIGURE 9.—Port of Vancouver departures by months for 1932. (Annual Report of the Vancouver Harbour Commissioners, 1932, p. 66.)

Ownership.—The elevators are for the most part semi-public ones. Three of them, the No. 1, No. 2 and No. 3 elevators, belong to the Vancouver Harbour Commissioners. The first of these is leased to the Alberta Pool, and No. 3 to the United Grain Growers Terminal, Ltd. The other elevators are used at the present time by the companies to whom they belong. The Alberta Pool belongs to the Alberta Pool Elevators, Ltd., the Vancouver Terminal Elevator to the Vancouver Terminal Elevator Company, the Midland Pacific to the Midland Pacific Elevator Company, and the Columbia Grain Elevator to the Columbia Grain Elevator Company, Ltd.

From 75 to 90 per cent of the wheat held in the Vancouver elevators is the property of the elevator companies, and the per cent seems to be increasing. A large amount of marketing thus enters into the operation of the Vancouver elevators. In this marketing, government or semi-public administration is usually likely to be less efficient than private concerns.

Character of Elevators in the Port.—Vancouver with a capacity of 17,728,000 bushels has the greatest grain elevator accommodation in any ocean port in the world. Montreal, the second largest in the world, has a capacity of 15,162,000 bushels.

There are seven massive structures which involve heavy foundation problems. These, as in most seaports, are kept separate from wharf foundations by using shipping galleries which permit the main elevator structures to be located well back from the waterfront (Figure 11). Therefore, heavy tonnage in grain may be stored without greatly taxing areas suitable for development because loose grain may be stored in bins of one hundred feet and more in depth. There is one small domestic storage elevator, Buckerfields, on the waterfront (Figure 11).

The seven exporting elevators have a combined receiving capacity of 126,000 bushels per hour, a combined drying capacity of 6,000 bushels per hour, a combined cleaning capacity of 152,000 bushels, and a combined shipping capacity of 377,000 bushels per hour. The elevators in Vancouver clean and dry grain, as at Fort William, and export grain, as at Montreal. The drying capacity is inadequate in early winter when shipping is at its height and the greatest strain occurs. In some periods 40 per cent of the grain must be treated because of the moisture content. Sir Alexander Gibb in his report on the Dominion ports recommended increasing the drying arrangements at the Port of Vancouver.

In loading grain at Vancouver, it is carried by belts through conveyor galleries over the pier or jetty to a point directly over the ship's hold. Then it is discharged through vertical telescopic spouts in the proper place. There are nineteen grain loading berths with ninety-three spouts. The combined

loading capacity to ships is 377,000 bushels per hour.

The Alberta Pool Elevator No. 1 is the largest, newest, and most modern of all the elevators in the port. It has a storage capacity of 5,150,000 bushels, a nominal receiving capacity of 54,000 bushels per hour, and a shipping capacity of 72,000 bushels per hour. It has three ship's berths. This elevator is built in a bay with pier and wharf parallel with the shore since there is ample space and water is deep. The functions of this elevator, as well as of the other elevators in Vancouver, are to receive grain for storage, clean and dry it, weigh it, and transfer it to ships. The unloading sheds are equipped with three Dominion-Howe car dumpers, having a capacity of one car every eight minutes each, and three pits for hand loading when needed. It has sixteen standard monitor cleaners which are very efficient in separating all varieties of wheat from other grain, such as rye, flax, oats, and barley.

Drying grain is an important function of Vancouver elevators. The Morris automatic grain driers are used in the Alberta Pool Elevator. In the top section, air is heated by passing through the grain at high velocity. The surplus moisture is removed by means of fans which carry the dust to a dust tower. In the bottom section, cold air is passed through the grain to make it ready for export.

The other elevators are smaller and less modern and efficient than the Alberta Pool. They are not supplied with car dumpers and most of them have less modern scales. The No. 1 Elevator has a storage capacity of 4,335,000 bushels; No. 2 Elevator, a storage capacity of 1,625,000 bushels; No. 3 Elevator, a storage capacity of 2,650,000 bushels; Vancouver Terminal, a capacity of 2,250,000 bushels; Midland Pacific, a capacity of 1,500,000 bushels; and the small Columbia Elevator has a storage capacity of only 333,000 bushels.

SHIPMENTS OF GRAIN AND FLOUR BY COUNTRIES AND GRADES

The United Kingdom has, since the beginning of grain export from Vancouver, been the largest importer. The Orient ranks second in importance while Central and South America, New Zealand, and Australia are only minor importers (Figure 12).

Shipments to the United Kingdom.—In the 1921–1922 crop year the United Kingdom imported 58 per cent of the grain exported from Vancouver. In

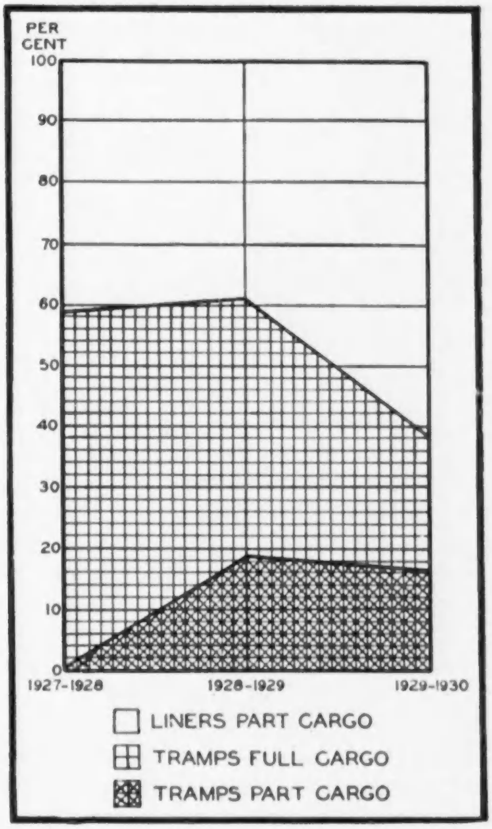

FIGURE 10.—Grain exports from the Port of Vancouver by liners and tramps for crop years, 1927 to 1930 inclusive. Percentages carried by each type of ship are placed upon each other so that they total 100 per cent. (Derived from Dominion of Canada National Ports Survey 1931–1932, by Sir Alexander Gibb, p. 155.)

1922–1923 it imported 79 per cent of the grain exported. In recent years it has imported an even larger per cent of the total grain exported from Vancouver. In 1931–1932 the United Kingdom imported 84 per cent of the total grain exported from Vancouver, and in 1932–1933, 87 per cent of the grain exported from Vancouver went to the United Kingdom. During a period of twelve years, between 1921 and 1933 the United Kingdom and Continent imported three-fourths of the total grain exported from Vancouver.

Up to 1923, practically no flour was imported by the United Kingdom and Continent. In 1923 this continent imported 7.3 per cent of the total flour exports from Vancouver (Figure 13). In the period between 1923–1931 an average of 12 per cent of the flour shipped went to the European market. Flour in bags is loaded on ships by means of canvas chutes containing continuous belts.

Shipments to the Orient.—The Orient market for grain has tended to increase, as the people are turning increasingly from rice to wheat. However, the per cent of the total grain exported from Vancouver to the Orient is small in comparison with that shipped to the United Kingdom and Continent. Considerable fluctuations are evident in the Orient market. It varied from 5.6 million bushels in 1929–1930 to 32.4 million bushels in the 1928–1929 crop year. The average grain shipped to this market for a period of twelve years, from 1921–1933 was 23 per cent of the total grain exported from Vancouver. (*Annual Statistical Report of the Vancouver Merchants' Exchange*, 1932, p. 1.)

FIGURE 11.—Four of the export elevators and one domestic storage elevator. These elevators are not crowded together, but have ample space for offices, switch tracks, and roads connecting them with the land. Burrard Elevator is Vancouver Harbour Commissioners' Elevator No. 1. (Courtesy of J. H. Hamilton, Secretary of the Vancouver Merchants' Exchange.)

Vancouver is the chief port of export for wheat flour of western Canada. China has been the best market for this flour exported from Vancouver. A yearly average of 80 per cent was exported to the Orient from Vancouver from 1923–1931 (Figure 12). Japan is a comparatively small buyer. As yet wheat flour is still a luxury, only used as a regular diet by the wealthier people. In recent years Japan has been doing considerable milling in her own country. At present she is capable of filling all

domestic requirements with considerable margin. China also has quite a few mills, but has not developed the industry as extensively as has Japan. Japan is an active competitor of Vancouver in supplying the Chinese market with flour. It has decreased Vancouver flour exports to this market (Figure 13). The construction of elevators in the Far East by means of which grain may be delivered in bulk instead of in sacks, will assist Japan in this milling industry. The success of this industry in Japan will determine the future of the flour exporting industry in Vancouver. The future outlook is rather dark for this industry.

Shipments to Minor Markets.—The other markets for grain and flour from Vancouver receive such small amounts as to be almost negligible. Central and South America combined with New Zealand and Australia received only an average of 1.5 per cent of the total grain exported from Vancouver during the period of twelve years, from 1921–1933.

Distribution of Grades.—Canadian wheat is classed in these grades: 1 hard, 1 N., 2 N., 3 N., No. 4, No. 5, and No. 6, feed, miscellaneous, oats, rye, and barley. 1 hard is spring wheat, Nos. 1, 2, and 3 N are good grade northern wheat. Numbers 4, 5, and 6 are low grade wheat, often containing weevils. Feed and miscellaneous grain are used for chicken feed largely. Very little grain other than wheat is exported from Vancouver. Of the grain exported from this port in 1932, only 7 per cent was grain other than wheat.

The United Kingdom and Continent, in general, import the better grades of wheat, while the Orient, more especially China, in general, imports the low grades. In the 1931–1932 crop year, 64 per cent of the total wheat imports of the United Kingdom and Continent from Vancouver were of the three upper grades. Fifty-four per cent of the total imported was 2 N. grade. Thirty-six per cent was of grades lower than 3 N. The Orient wheat imports for the same year were made up of 33 per cent of the three upper grades (20 per cent was the two lowest grades shipped), 36 per cent was of grades lower than 3 N, and 47 per cent was of medium grades.

Statistics show a growing tendency of the Orient to import better grades of grain. In the 1928–1929 crop year, 97 per cent of the wheat export from Vancouver to Oriental markets was of grades lower than 3 N. In the 1930–1931 crop year and also in the 1931–1932 crop year approximately two-thirds of the wheat imports of the Orient

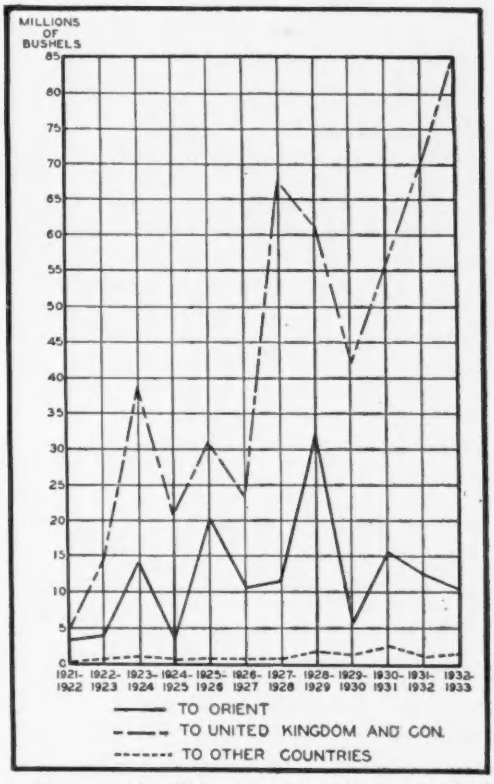

FIGURE 12.—Shipments of grain to principal market areas in million bushels, 1920–21 to 1932–33 inclusive. (Vancouver Merchants' Exchange, Vancouver Grain Shipments Report, Aug. 1, 1932; and British Columbia Today, p. 15; and Interview with Vancouver Merchants' Exchange.)

from Vancouver were grades lower than 2 N.

SUMMARY

Grain has shown the most phenomenal rise of any export of Vancouver, yet it is the newest product in port trade. Vancouver now ranks first in export of Canadian grain, largely wheat. It would seem that it might continue to do so since this port is open throughout the year and since the wheat lands are steadily extending westward. However, rail rates, partly because of the Rocky Mountains, still favor the eastern grain export route through Montreal.

Most of the wheat exported from Vancouver in 1932–1933 came from western Alberta; some came from eastern Alberta. Vancouver exported 55 per cent of Alberta's wheat during that crop year. Little, if any, of the wheat produced in Saskatchewan passes through Vancouver, except occasionally in winter when the lake route is closed by ice.

Because of the lumber trade, Vancouver is quite a tramp port. In recent years, less and less grain tends to move by typical tramp steamers in full cargo lots. Grain moves partly in chartered vessels for scheduled or semi-scheduled sailings and partly in liners. In 1929–1930, 61 per cent of the total bulk grain moved by liners, 16 per cent of the total moved in tramp vessels taking part cargo, and 23 per cent moved in tramps taking full cargo. In more recent years the quantity carried by tramps has decreased and liner carriage has increased. This change has come about because liners carrying products to Europe are assured available grain to fill the holds of ships.

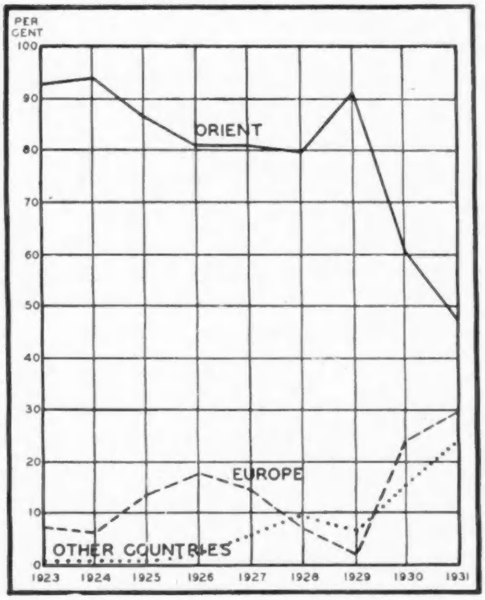

FIGURE 13.—Flour exports from the Port of Vancouver in percentages by continents for calendar years 1923 to 1931 inclusive. (Derived from Dominion of Canada National Ports Survey 1931–1932, by Sir Alexander Gibb, p. 160.)

The United Kingdom ranks first in importation of Canada grain. The Orient ranks second, and Central and South America, New Zealand, and Australia are only minor importers. The United Kingdom imports chiefly good grade wheat, while that shipped to the Orient is mainly low grade. There has been a tendency, however, for the Orient to import better grades of wheat recently.

NOTE.—Statistics used in this article were obtained principally from the reports and unpublished records of the Vancouver Merchants' Exchange through the courtesy of J. H. Hamilton, from the Canadian Grain Trade Year Books, from the Annual Reports of the Vancouver Harbour Commissioners, and from the Dominion of Canada National Ports Survey 1931–1932, by Sir Alexander Gibb.

THE LAKE PORT AT TOLEDO

Walter G. Lezius

PERMANENT occupancy of the lower Maumee River by white man began in the latter part of the seventeenth century with a stockade built by some of the earliest Ohio settlers, during a period when the relative ease of contact which such a location afforded was of paramount importance. The colony's steady growth resulted largely from the strategic geographical position in transportation which the navigable waters of Lake Erie, Maumee Bay, and the lower Maumee River and the level land of the Lake Plains and gently undulating topography of the Maumee Valley gave it. Contacts thus provided by the natural environment fostered the economic activities of the settlement.

The history of Toledo itself began with the merging, in 1837, of two adjacent and competing towns known as Port Lawrence and Vistula. Their sites had many advantageous geographical features which have since been reflected by Toledo itself. Toledo's situation near the debouchment of Maumee River at the westerly extremity of Lake Erie has given it a favorable location with respect to receipt and distribution of basic raw materials such as coal, ore, sand, gravel, grain, petroleum, and limestone. The element of accessibility has encouraged sufficient trade through the years to make this port one of the important bulk commodity ports of North America both with respect to volume of traffic and handling facilities. A major problem confronting this trade center is whether certain necessary conditions for future commercial and industrial development will be anticipated and provided for or whether growth will continue in an unplanned, haphazard, and consequently uneconomical fashion.

Evaluation of Harbor Conditions

Toledo has an exceptionally good harbor formed by the Maumee River and the lake embayment. The entrance channel through Maumee Bay and the lower reaches of the Maumee River is relatively easy to navigate. It presents no major navigation problems. Maumee Bay is shallow, having a depth of about 6.5 feet and numerous sand bars, but it is easy to dredge. The alluvial bottom is favorable to good anchorage. The navigation channel from deep water in Lake Erie has recently been increased to 25 feet in depth with 2 feet overdepth and a minimum width of 400 feet 16 miles upstream to Fassett Street Bridge (Figure 1). Nine miles of this distance is through the bay and seven miles in the river. This channel will tend to be reduced by wave action and silting, necessitating some dredging each year. The harbor, though very spacious as compared with other Great Lakes harbors, does not have sufficient mooring room for all the freighters which might be attracted. For this reason among others, Toledo has lost business which its natural setting it seems should have gained.

The harbor is essentially tideless and devoid of strong currents. The current in the dredged portion of the river is negligible, normally being less than one mile per hour. Occasional strong winds produce strong currents for short periods only. The river level rarely fluctuates as much as 9½ feet above and 6½ feet below low water datum. The former level occurs during spring freshets or

when a strong wind blows from the northeast, thereby piling up water in the bay and river and for a short time, perhaps, reversing the direction of flow. Conversely, during periods of drought or when strong land winds blow water of the river and bay out toward the lake, the river level is noticeably reduced. Fluctuations do not ordinarily exceed about 4 feet above and 2 feet below low water datum. Fogs occur during the autumn and winter months with normal frequency for a Great Lakes harbor, but there are very few days each year during the Maumee River and outer harbor is about 580 feet. Much of the land around the harbor is below the 600-foot contour.

The chance to acquire new land suitable for commercial and industrial purposes is a factor of major significance in scientific plant location. Toledo's harbor provides essentially unlimited possibilities for such expansion. A portion of the potentially usable land adjacent to the Maumee Bay has poor drainage. However, this condition may readily be rectified by using the dredged harbor silt

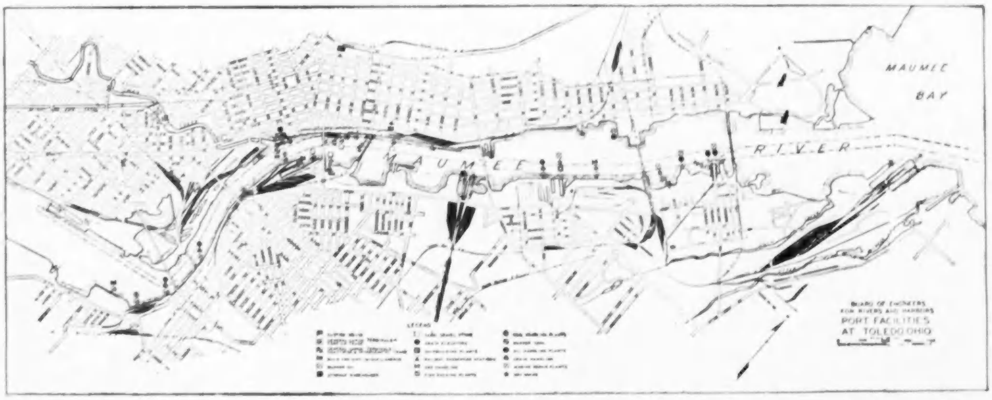

FIGURE 1.—Few lake ports can boast of having as good physical layout as that at Toledo. Port facilities, illustrated on the map, are notably well developed. It seems that the up-river wharves (in the vicinity of Fassett Street Bridge) should have been originally located along the east shore of Maumee Bay in order to allow the greatest efficiency.

which dense fogs appear. The average closed season at Toledo's harbor exists for one week less than three months. The harbor is not normally closed by ice for a period in excess of that of any other harbor on the Great Lakes. In fact its closed season in most years is considerably shorter than that of most other harbors in this region. The comparatively short closed season attracts freighters for winter mooring.

A low shore line of unconsolidated materials favors an economical transshipment of cargoes and expansion of commercial and industrial layouts. Lake Erie is about 572 feet above sea level while land adjacent to the mouth of for fill-in purposes. Such procedure would represent a wiser adjustment to the natural environment than exhibited by the usual method of conveying the harbor silt out to deep water where it is deposited. Established harbor lines are well beyond the present shore line which will allow for the reclamation of much land now under shallow water.

EVALUATION OF PORT CONDITIONS

The harbor situation just described does not imply trade. In addition to beneficial haven features are certain aspects of port development which account for Toledo's prominence as a Great Lakes port.

Nearly all quayage facilities are located along the right bank of the Maumee where there is an abundance of room. They are used for loading and discharging bulk commodities of low unit value. Special equipment is provided for the handling of coal, ore, cement, sand, gravel, grain, and oil. Coal terminals are equipped with electric and steam-operated car dumpers (Figure 2). Ore huletts are the common movable electric unloaders. Sand, gravel, and similar cargoes are handled by locomotive cranes with clamshell buckets, derricks, and bucket elevators. Package freight is transferred by mechanical appliances, hand trucks, and vessel's rig. Automobiles are moved under their own power. Mechanical facilities for conducting trade are in general on a parity with other leading Lake Erie ports. The coal dumping and ore unloading equipment at Presque Isle (at the junction of the river and bay) and that along the east bank of Maumee River is among the best of any world port. It would be well to have a competent port authority, however, that might administer port problems such as sponsoring the improvement of rail alignments, warehouses, and many of the wharves in so far as port improvements are not undertaken by the Federal Government.

Abandonment of obsolete port equipment as instanced by certain freight stations, coal piers, and classification yards, and the consolidation of other equipment considered relatively new and efficient, would be a desirable measure. It has long been suggested, for example, that the B. & O. Coal Docks be completely abandoned due to their poor location upstream from the Fassett Street Bridge. All coal cargoes, with allowance for a great increase in business for many years to come, may be handled adequately at the C. & O. and N. Y. C. Docks.

Railroads serving the port area are

FIGURE 2. Coal dumpers and ore unloaders along the east bank of the Maumee River near the Toledo High Level Bridge. Classification and storage yards may also be seen. Coal can be dumped at the rate of 16,500 tons per hour. The capacity of the ore huletts is 600 tons per hour. The splendid physical layout of the Maumee and adjoining docks illustrates the relative ease of cargo transfer between land and water at some parts of the port of Toledo.

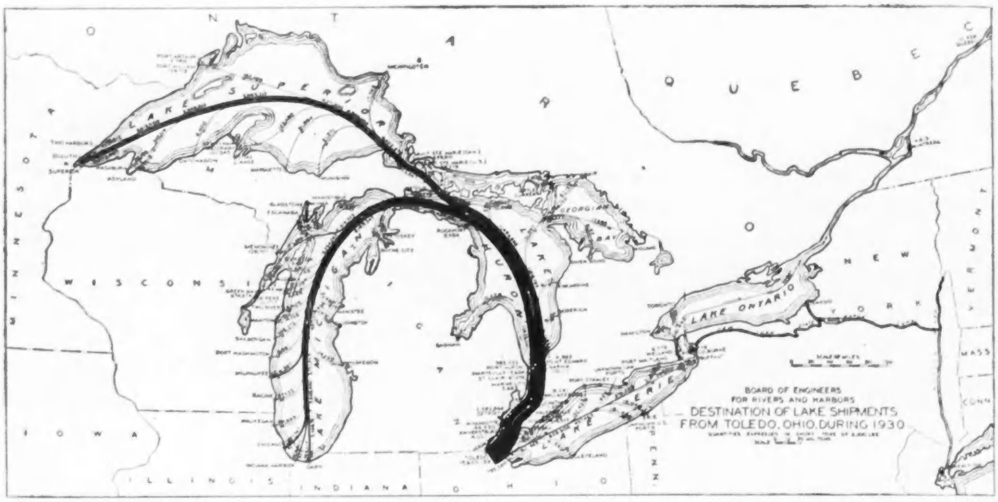

FIGURE 3. Shipments from the port of Toledo are made mainly to those upper lake locations which place large orders for lake coal. This business is great enough to classify Toledo with the leading coal-shipping ports of the world.

more than sufficient to meet present trade needs. A belt-line railroad coördinates the many rail lines and spurs of Greater Toledo with the water front. All wharves at which boats regularly berth have rail spurs which join main railroads directly or connect with the belt line. A movement is now under way to consolidate the many competing lines in order to eliminate duplication of effort, promote economical port operation, and in general to increase port efficiency. Several million dollars might be saved yearly by an economical consolidation of some, and elimination of other, rail facilities serving the port. The sixteen railroads now operating in the Toledo area might be regrouped into perhaps two principal systems.

The port's strategic location upon the Great Lakes trade route plus low water freight rates have contributed to its growth. These rates have extended the port's hinterland many miles beyond what it might have been were there no lake route. That the size of the immediate producing and consuming hinterland has been enlarged in consequence of the port's favorable location is attested by the fact that Toledo has become one of the largest railroad centers of the United States.

That portion of the port's rich producing hinterland which is of prime importance consists of coal fields located in West Virginia, southeastern Ohio, and eastern Kentucky. Coal, passing over the docks at Toledo, is for the most part destined for upper lake ports, primarily the Chicago, Detroit, Milwaukee, and Duluth districts (Figure 3). Among the lesser items of trade is iron ore sent from Mesabi Range of northeastern Minnesota together with receipts from other ranges in the Lake Superior district (Figure 4). Sand and gravel are brought in from a variety of places among which the vicinity of Sandusky Bay and neighboring islands is most important. Grain is received from the Great Plains via Duluth and Chicago. Petroleum is received from the Mid-continental and Gulf fields by pipe line and barge.

Reference may be made to the Annual Report of the Lake Carriers' Association, or to Lake Series No. 7 prepared by The Board of Engineers for Rivers and

Harbors, to obtain detailed information concerning quayage facilities, freight and transfer rates, and the like. Freight rates published therein explain in part why Toledo is an important transshipment gateway. In illustration, railroads publish rates for coal from those mines of the Middle Appalachian Field from which the bulk of lake coal originates only to Toledo and Sandusky. Thus, these ports are unmistakably at a decided advantage. Without further manipulation, freight rates will favor Toledo for the most part, not because they are discriminatory in this case, but because of Toledo's location in terms of geographical distance.

PORT ADMINISTRATION

The director of public service supervises port affairs. A harbor master, responsible to the director, has authority to enforce the city ordinances pertaining to navigation of vessels in the harbor. A port commission serves as an advisory council to the director.

The more progressive port authorities or commissions at some of the world ports have deemed it well to provide port improvements for the people at large rather than for a few individual interests. A great stride in this direction is public acquisition of ownership of the entire water front. The following table states the ownership, length, and development of the water front on both sides of the Maumee. It will be noted that the

Owner	*Linear Feet*	*Per Cent of Total*	*Linear Feet Developed*	*Per Cent of Total*
City of Toledo.	9,345	10.72	980	1.12
Railroads	47,400	54.38	20,000	22.94
Local interests.	30,430	34.90	14,550	16.69
Total.....	87,175	100.00	35,530	40.75

railroads own and have developed most of the water front while the city has merely a small share, very little of which is developed. At the time of this writing, legal questions as to riparian rights are being investigated by the port commission so that the Federal Government might undertake to provide a mooring basin along the west side of Maumee Bay. In order to expedite improvements it seems advisable for a port district to be incorporated, owned publicly, and managed by a port authority. As a result of experience by other ports, care must be taken that the port authority actually exercises authority in supervising port affairs so that this title does not prove to be a misnomer.

COMMERCE

The value of the water-borne commerce is relatively low because virtually all port business is in bulky commodities of low unit value. Still, the comparative rank of Great Lakes ports from 1921–1930 reveals the fact that Toledo's tonnage is exceeded in volume only by the twin port at Duluth-Superior and by Buffalo. The port's total annual business during this decade averaged approximately fifteen million tons. It outranked all Great Lakes ports in 1930 except Duluth-Superior. Even more promising for its prestige and future growth is the 112% increase in volume of tonnage between 1921 and 1930. In excess of 18,300,000 tons were moved in 1934. Preliminary figures indicate that the total port business in 1935 amounted to approximately twenty million tons.

Toledo terminals handle more than two-fifths of all soft coal shipped from Lake Erie ports. Coal accounts for nearly all of the outbound traffic, petroleum products ranking second but shipped in almost negligible quantities. Iron ore is the principal item received. Sand and gravel are next in importance among the receipts, followed by coal and grain in small quantities.

Some of the commerce data are shown graphically in Figure 5. The importance of freight rates in altering com-

merce may be noted incidentally. Toledo ships quite as much lake cargo coal as the combined tonnages of all other Lake Erie ports. Still, coal is received at one of Toledo's docks from Sandusky. The explanation of this obvious paradox is that, in order to encourage shipments of coal to upper lake ports, the combined rail-lake haul on coal via Sandusky to Toledo (in this case considered an "upper lake port") is lower than the pure rail haul directly to Toledo. More specifically, the all-rail rate for coal to involved, in order to secure the lake cargo rate. To illustrate further, 8 cents per ton for transshipment at Sandusky plus 30 cents for water transportation from Sandusky to Toledo must be added to the lake cargo rate from the mine-mouth. Such procedure involves a saving of 20 cents per ton from the inner crescent mines and 30 cents from the outer crescent mines. This is clearly a case of local discrimination. A freight rate map is distinctly different from a map showing geographical distance.

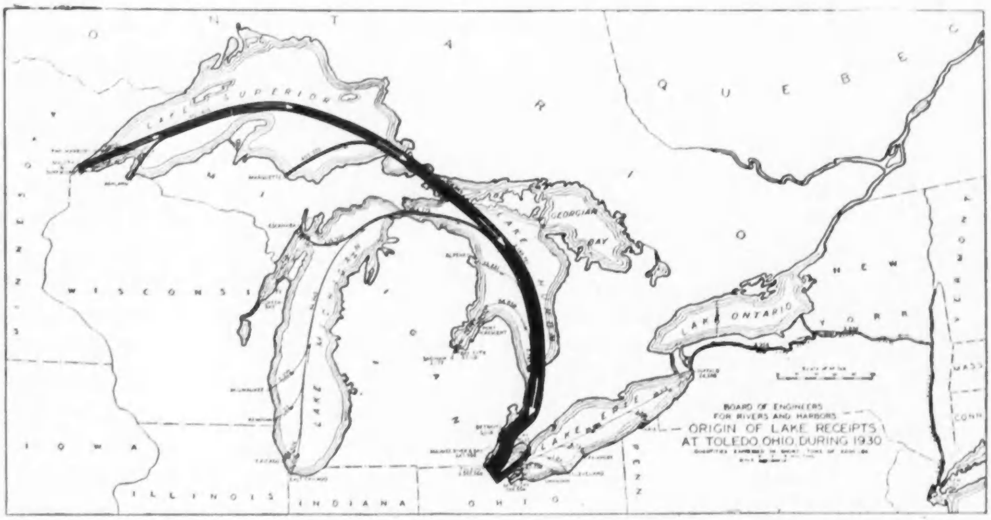

FIGURE 4.—Shipments to the port of Toledo are made mainly by those upper lake locations (Duluth and Superior, Ashland, Marquette, and Escanaba) from which iron ore is received.

Sandusky and Toledo from inner crescent mines (a classification of coal mines according to location, i.e., those of West Virginia and Kentucky that are nearest to the southern shore of Lake Erie; the so-called outer crescent mines are also of the Middle Appalachian Coal Field, but more distant from Lake Erie) is \$2.39; from outer crescent mines the rate is \$2.64. The lake cargo rate (combined rail and lake) is \$1.81 from the inner, and \$1.96 from the outer crescent mines. It is thus less expensive to bring coal in for use at Toledo via Sandusky rather than a direct rail haul to Toledo, regardless of the additional distance and service

The business depression of the past several years apparently ended for the port of Toledo during the navigation season of 1933 as evidenced by the remarkable increase of coal and iron ore movements. The total commerce in 1933 amounted to 17,778,320 tons as compared with 14,703,980 tons and 9,626,509 tons in 1931 and 1932 respectively. The tonnage handled during the navigation season of 1935 was greater than ever before.

CRITIQUE

Failure to attract industries well suited to Toledo has been noticeable in

many respects as evidenced by: boats desiring to moor at Toledo but because of insufficient room have proceeded to other ports; absence of large iron and steel plants that would have lower assembly and distributing costs than those at a center such as Youngstown; scarcity of foundry and machine shop industries that might serve Michigan centers more cheaply than those of Cleveland; lack of additional automobile plants which might have been established in Toledo.

It is of utmost necessity that Toledo be alert to keen business rivalry so that it does not lose any of the commercial or industrial advantages acquired from nature or civic action. Some of Toledo's natural advantages may be altered by artificial changes. Numerous trade centers have been known to rise and fall as a result of geographic or economic changes. If lake-rail coal rates to other points of transshipment such as Sandusky or Cleveland are lowered sufficiently as a result of aggressive port competition, Toledo would lose much business to these ports. The Northern and Middle Appalachian Coal Fields, common to Lake Erie ports, would then be in reality farther from Toledo.

Conversely, attention to the economic needs of this trade center should result in a steady growth of business which the natural environment certainly favors. Rather than to seek growth through competitive advertising, Toledo may well adopt a policy of so improving its economic conditions that additional trade will be stimulated automatically. It is suggested that the future port administration at Toledo carefully consider the policies adopted at so progressive a port as Hampton Roads, Virginia, and some of the largest world ports such as London, Hamburg, or Amsterdam.

Federal and local expenditures, as well as those made by private interests, for harbor improvement at Toledo from 1866 to 1931 have been little more than \$6,000,000. The annual appropriation by New York State in retaining its canal system averages \$3,500,000. The port of Toledo in one year (1929) moved more than 19,000,000 tons as compared to the entire New York State Barge Canal System which in its peak year (1930) moved only 3,500,000 tons. In other words, the annual maintenance and operation cost of New York's canal system is about one dollar per ton moved, while that for Toledo's port has averaged about one-half a cent per ton moved.

The port has assumed national significance as a result of its favorable geographical position and superior port, in spite of the lack of proper port management. It is unfortunate that the geographical index number for Toledo is comparatively low. The term "geographical index number" used herein refers to the intensity of the Toledoans' use of their geographical environment. The complete utilization of all its geographical assets would award Toledo an index value of 100. The utilization intensity ratio, although subject to some conjecture, is remarkably low as evidenced by much potentially valuable land which is essentially unused in the proposed outer port district, the outstanding need for the creation of additional mooring space, and the failure to attract particular commercial and industrial enterprises which perhaps would have found the location at Toledo more desirable than that eventually chosen.

New Deal for Port of Toledo

Although the port of Toledo has attracted much business, it has thwarted business in particular instances as a result of unorganized effort and artificially adverse conditions. A pronounced attempt is now being made to improve this situation. A new port commission has recently undertaken the

task. The next logical move in the evolution of port administration at Toledo is the establishment of a port authority with powers for effective management of port affairs.

The new deal entails such betterments as a new mooring basin in the west portion of the Maumee Bay, with a water front park and other reclaimed land made of the dredged earth. A turning basin is being provided near the head of navigation of the Maumee. A shore erosion prevention project is partially completed. The navigation channel has recently been increased to a minimum depth of 25 feet, with a width of 400 feet in the river section and 500 feet in the bay. A revival of the shipbuilding business is anticipated inasmuch as there is hardly any better location on the Great Lakes for this industry than at Toledo.

Proposed alterations of the port consist of new quayage facilities along the lower west shore of the Maumee River and east shore of Maumee Bay as warranted by future increases in business. There are no industries located adjacent to Maumee Bay. A large area along its east shore is well suited for quayage facilities and heavy manufacturing plants. Ships docking at the proposed Bay wharves would not be confronted with river navigation. It should be noted incidentally that four railroad and three highway bridges span the Maumee at Toledo. The use of wharf frontage above Cherry Street Bridge by large boats should be discouraged. Development of the outer harbor seems to be logical and practical as business is enhanced. It seems best to allow the entire west shore of the Bay as far as Ottawa River to remain as park and residential districts. In that the prevailing winds blow from the southwest, these west-shore districts will not be annoyed by smoke from the above-proposed commercial and industrial sites.

The inauguration of a trade promotion scheme insuring economical port operation will be forthcoming when the city becomes adequately impressed with its necessity. Future progress of the port, however, will not be impelled by environmental qualifications but rather will necessitate the application of man's initiative and ingenuity to bring about the most effective returns from the setting which nature has afforded.

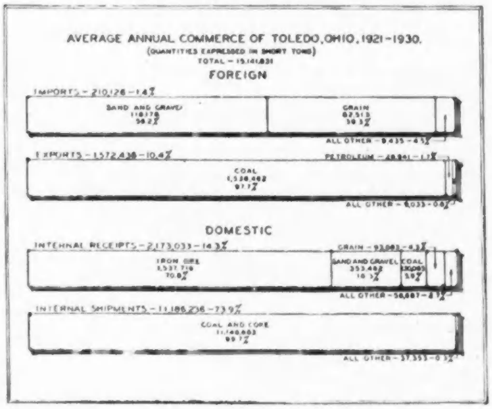

FIGURE 5.—Domestic shipments rank first, normally occupying about three-fourths of the total traffic. Domestic shipments have been more than five times as great as domestic receipts during the last fifteen years. Soft coal and coke constitute practically all of the total domestic shipments with an average movement in excess of ten million tons. More than fourteen and a half million tons moved out in 1927. All other items, comprising less than one-half of one per cent, consisted principally of fuel oil, gasoline, automobiles, wheat, limestone, and pig iron. Domestic receipts rank second, normally occupying about one-seventh of the total, or close to two million tons. Iron ore is the most important receipt, averaging seven-tenths of the total. Sand and gravel has second place in receipts, while coal ranks third, and grain fourth. The following commodities in combined amount usually account for less than three per cent of the domestic receipts: flax, petroleum and products, coke, phosphate rock, sulphur, cement, limestone, and some miscellaneous freight. Foreign trade involves a very small share of the port's business; exports constitute one-tenth, imports one-seventieth of the total. Sand and gravel, which have shown a relative increase, account for most of the imports. Grain, flax, lumber, lath, wood pulp, and trap rock are imported in very small amounts. Nearly all exports are comprised of coal. Petroleum products is the only other class of commodities of any consequence. Outbound movements of corn, rye, and wheat are almost negligible.

GEOGRAPHIC ASPECTS OF THE GERMAN TOURIST TRADE

Arthur C. Selke

THE *Reich* was not the first country to develop a scientific study of tourist trade. Italy led the way. Mariotti, director of the *Ente Nazionale per le Industrie Turistiche* and professor at the University of Rome, in his book, *Lezioni di Economia Turistica,* published in Rome in 1927–8, laid the basis for a scholarly study of the subject. Other countries—France, Spain, Austria, Greece, and Jugoslavia—have made contributions to the study of tourist trade.

Recognizing the importance of a scientific study of *Fremdenverkehr,* or tourist trade, Germany immediately fostered it. The Italian model was imitated by Professor Robert Gluecksmann in organizing the "Institute for the Development of Tourist Trade," associated with the School of Economics at Berlin (*Forschungsinstitut fuer den Fremdenverkehr, angegliedert der Handelshochschule*). This school offers a wide variety of courses, including legal aspects, economics, bookkeeping for hotel- and inn-keepers, exercises in the study of tourist trade, methods of attracting tourist trade, tourist trade statistics, and the geography of *Fremdenverkehr* with views and field trips. A large variety of courses bearing on the problem, such as geography, climatology, balneology, medicine, psychology, government, and sociology are also offered. This institute issues a quarterly publication, *Archiv fuer den Fremdenverkehr,* concerning the economic conditions in the tourist and allied trades; besides publishing books regularly on such subjects as Berlin hotels in the tourist trade, theories of the tourist trade in Europe, and analysis of the tourist trade in Upper Silesia. However, many other of the higher schools besides the one at Berlin offer similar courses to analyze and stimulate a scientific study of tourist trade. Careful statistics have been gathered concerning the amount and distribution of this type of passenger traffic in order to encourage its development intelligently. In Bavaria tourist trade figures were kept even before the World War and 938 communities there reported statistics for *Fremdenverkehr* in 1930. Wurtemberg has kept figures on it since 1923; Saxony, limited statistics since 1921; Baden, beginning its collection of tourist statistics late, kept very comprehensive figures. Thuringia and Hesse kept state statistics, and Hamburg, Bremen, and Luebeck, statistics for city tourist trade. Prussia, constituting the greater part of the country, has developed tourist trade statistics since 1927. There were few sections of the country, in fact, without such figures by 1930.

STATISTICAL ASPECTS

Various types of *Fremdenverkehr* statistics are kept. Usually two methods are used in securing such statistics: first, a count of the actual number of tourists in any locality regardless of length of stay, and, secondly, a count of the actual number of overnight lodgings. Both of these figures are easy to obtain because of the passport system prevailing there. The former method is more important from the standpoint of transportation, the latter from the standpoint of the communities visited. From the viewpoint of transportation the length of

journey would furnish the best statistical criterion, but this is very difficult to compute. Needless to say, there is no good single index for measuring tourist trade. Borman, in his book, *Die Lehre vom Fremdenverkehr,* estimated roughly that 18.5 million tourists occupied the 56.7 million beds away from home in 1928 and that 4.3 million, or 7.6 per cent, of these tourists were foreigners.

The foreign tourist trade shows some interesting trends. The United States easily contributed the most visitors in 1928. The chief reason, no doubt, is that Americans, with more wealth per capita, visited all countries more than did those of other nationalities. But another reason is that since Germany has contributed more immigrants to the United States than any other country of which we have a record, naturally many Americans would be eager to visit the land of their ancestors. Of the total overnight lodgings by foreigners, 762.2 thousands, or 17.6 per cent, were by people from the United States in 1928. The Netherlands are responsible for 513.5 thousand overnight lodgings, or 11.8 per cent; Austria, 500.1 thousand, or 11.5 per cent; and Great Britain, the three Scandinavian countries taken as a whole, and Switzerland, 7.9, 7.7, and 5.9 per cent, respectively. The fact that Czechoslovakia used but 5.5 per cent, Poland but 4.6 per cent and France but 2.9 per cent of the overnight lodgings shows that the Slavic and French peoples, although neighbors, visit Germany but little. The influence of neighboring countries on individual states of the *Reich* is also noticeable. Austria contributed the most tourists to Bavaria in 1928; Czechoslovakia and Austria to the Free States of Saxony; the United States overwhelmingly to Baden, with the Swiss a not very close second. The United States led, and the Scandinavian countries came second, as visitors to the old Hanseatic cities.

FACILITIES

In order to accommodate a growing intra-national as well as international tourist trade, the country must utilize a variety of facilities, the chief of which are the various conveyances of passengers. The most gigantic agency for passenger transport is the *Reichsbahn.* From 1926–1929, inclusive, it transported 13,823; 14,635; 15,235; and 14,597 millions of persons, respectively, in each of the four years. It is noteworthy that in 1928 the railroads carried 76 per cent of the tourist trade. Their closest competitors were private automobiles, carrying 12.0 per cent. With increasing mechanization of Germany, it is safe to predict that the automobile will continue to gain at the expense of other modes of travel, particularly as the

TABLE I

TRANSPORTATION BY VARIOUS MODES OF TRAVEL IN GERMANY IN 1928 (a)

Modes of Travel	*Number of Passengers Carried, in Millions*	*Number of Passenger Kilometers Traversed in Millions*	*Of the Passenger Kilometers the Following Are Attributed to Tourist Trade. In Billions of Passenger Kilometers*	*Per Cent*
Reichsbahn	2,009.4	47,649	20–25	72.2
Private railroads	88.8	1,421	1–15	4.0
Side line railroads	108.0	1,296		
Street railways	4,284.0	22,000	.....	....
Inland waterways	5	200	0.1–0.2	0.5
Buses run by railroads	2.2	.....	.....	....
Postal buses	68.8	2,500	2–2.5	7.2
Auto transportation companies	74.2			
Private autos	350	11,000	3.5–4.0	12.0
Airplane (*Lufthansa*)	0.12	28.9	0.03	0.1
Coastal shipping	0.5	2,000	1.0–1.5	4.0
			27–35	100.0

country becomes more prosperous and as prohibitive taxes on automobiles are lowered. Airplane and inland water passenger traffic is so seasonal that it must be considered largely tourist trade. Even so, the two carry only about 1.0 per cent of the estimated tourist trade of the country.

Among the facilities, accommodations play a vital part in the encouragement of the nation's tourist trade. Special efforts are made to provide accommodations that will attract tourists, although not to the extent that this is done in Switzerland. A typical classification of German accommodations is the following:

1. Hotels, inns, hospices (*Hotels und Gasthoefe*).
2. Convalescent and rest homes (*Erholungsheime*).
3. Sanatoria and spas (*Sanatorien*).
4. Boarding houses (*Fremdenpensione*).
5. Private quarters (*Privatquartiere*).
6. Shelters for hikers and young people (*Wander-und Jugendherberge*).

Hotels and inns are not very different from those of other lands, except that the smaller inns, while scrupulously clean, have few of the elaborate plumbing fixtures to which Americans are accustomed. Rest and convalescent homes, spas and sanatoria, are much frequented by Germans, who do not necessarily wait until they are very ill. Boarding houses (*pensione*) and private quarters are satellites of all the aforementioned accommodations, taking care of overflow trade. Shelters for wanderers and young people are distinctly German institutions. The youth of Germany, as part of the Youth Movement, has for some years been organized for wandering. Students and others hike or go by bicycle long distances. In 1932 there were over 250,000 organized wanderers there; 2,468 wanderers' associations, owning 70 inns at scenic places, 73 observation towers, 230 shel-

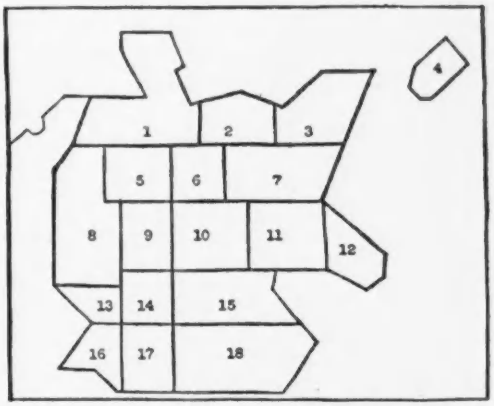

FIGURE 1.—1. Northeastern Germany, North Sea, and the Hanseatic cities. 2. Mecklenburg, Germany's land of lakes. 3. Pomerania and Baltic Sea bathing resorts. 4. East Prussia with Masurian lakes. 5. Westphalia. 6. The Harz. 7. Berlin, Potsdam, and Brandenburg. 8. The Rhine and its lateral valleys. 9. Cassel and the Weser. 10. Thuringia. 11. Saxony. 12. Silesia. 13. The Palatinate. 14. The Main and the Rhine. 15. The towns of Northern Bavaria. 16. Baden. 17. Wurtemburg. 18. Munich and the Bavarian Alps. Schematic division for tourist trade purposes. Such schematic caricatures of maps are commonly used in Germany.

ter huts, thousands of rest benches, water fountains, and guide-posts which marked over 55,000 kilometers of pathways for tourists. Additional cheap accommodations are also provided, especially by cities in favored tourist sections. The most widely used of this type of inn is the *Jugendherberg*. In 1931 there were 2,300 *Jugendherberge*, sheltering almost 5,000,000 wanderers, a growth within twenty years from seventeen such inns with 3,000 overnight visitors.

Tourist bureaus and other organizations operate to facilitate the nation's tourist trade. These organizations which are found in all large cities, include, in addition to the regular bureaus, travel and youth associations, bath organizations, unions of hotels and taverns, and chambers of commerce. Transportation companies of course lead in the number of bureaus. In many depots of the national and private railroads there are tourist informa-

tion booths. The MER (*Mitteleuropaeische Reisebuero*) was in fact organized to serve the *Reichsbahn* and various German, English, Italian, and French ocean shipping lines. In 1931 there were about 220 MER tourist bureaus. The North German Lloyd and Hamburg American steamship companies maintain their own, while the *Reichspost* (Federal Postal Service) functions also to advertise German tourist facilities. Foreign companies also operate tourist agencies in Germany, such as Thomas Cook and Sons, the I.S.G., the American Express, and all the leading steamship lines. Geographical influences are apparent in many of the tourist agencies. The fact that there are such organizations as an "Official Bavarian Travel Bureau," with over 100 agencies, and a *Landesverein Badische Heimat,* an association for the development of Baden, shows the influence of the old political divisions. Other organizations like the Oden Forest Club, the Black Forest Ski Club, and the Harz Club are the results of regional influences. The bureaus, associations, and clubs which foster tourist trade are by no means unimportant. As early as 1925 the Union of German Travel Bureaus, operating but a fraction of the tourist bureaus of the land, had 364 agencies employing 2,072 persons. In Berlin and other cities whole sections of newspapers are devoted to advertising resorts, spas, hotels, winter sports, and other tourist interests. Expenditures to attract and facilitate the visitors are enormous in Germany. These agencies are supported partly by sale of bulletins and tickets, but all bureaus are kept up largely from private and public subsidies.

GEOGRAPHICAL ASPECTS

Tourist bureaus and other agencies find it easy to stimulate tourist trade, for Germany has many physiographic advantages to attract visitors. In fact, so thoroughly has the idea been sold there that the country has been divided into eighteen distinct tourist regions. Climate and topography exert great influence upon the extent and direction of *Fremdenverkehr*.

Influence of Climate. Naturally enough, summer is the favorite season for tourist trade. Only under the most exceptional conditions will any other season bring as many tourists. The warmer temperature of summer is no doubt the biggest factor, but the greater amount of daylight for observing scenery and the greater amount of sunshine also enhance the value of summer for vacationing. The passenger traffic on the Rhine river, chiefly tourist trade, was distributed monthly on the boats of one company, during 1927–1929 inclusive as follows: April, 1.1 per cent; May, 11.3; June, 17.8; July, 26.7; August, 27.8; September, 14; October, 1.3; November, December, January, February, and March, 0.0 per cent. In air transportation we find similar trends. In 1929 there were only a few more than 200,000 plane kilometers flown in January, the poorest month, while in July and August, the peak months of the year, there were more than 1,400,000 plane kilometers flown on the regular routes. In bus traffic of the *Reichspost* we find similar trends. Nine of the 23 bus lines under the direction of the division of Brunswick are run only in summer; 21 of the 71 bus lines under the jurisdiction of the division of Erfurt; five of the 21 of the Stettin division; and eighteen of the 43 postal lines directed by Munich are summer lines only. One might indeed be led to suppose from these figures that summer is the only season important in the tourist trade of Germany, but other seasons also draw traffic.

Germany makes a serious bid for the winter sports trade that would otherwise go to Switzerland, Austria, and other lands. Dependability of snowfall is so important for winter sports that daily government reports list the snow in all important newspapers, in depots, and over the radio. Snow is by no means permanent in many sections of the country. Only the eastern part has any appreciable snow at sea level. Koenigsberg in East Prussia had a cover of 94 millimeters in 1929, whereas Cleves in western Germany near the Netherlands had but 26 millimeters. Quite naturally the highest points have the greatest precipitation. The Zugspitze of Bavaria, the highest point, had 294 millimeters of snowfall; Schneekoppe, Bavaria, had 201 millimeters; Feldberg in the Black Forest had 196; the Fichtelberg in Thuringia, 157; Brocken in the Harz, 161 millimeters. These are among the dependable winter sports centers of Germany, where skiing, ski-kjoering, mountain climbing, curling, bob-sledding, horse racing on ice, tailing, figure skating, ice dancing, and hockey are engaged in. Because the places where winter sports are practised are also scenically desirable in summer it is difficult to isolate winter sports statistics. In the Feldberg, Baden, region, February has the greatest tourist trade, although the summer months closely approach it. However, if the January tourist trade is large when compared with the autumn trade, one may perhaps assume that winter sports were the attraction. Hoechenschwand in the Black Forest, 1,108 meters above sea level, had 67 tourists staying a total of 2,090 nights in 1930, a figure exceeded only during July and August. In a similar manner, St. Blasien in the Black Forest had 836 guests in January, a figure exceeded only by the three summer months.

A rather amusing corollary on the supposed climatic advantages of certain German resorts is the multiplicity of the so-called *Luftkurorte* (fresh air health resorts), where the attraction is no doubt the ultra-violet rays. Of 204 health resorts listed for Baden, 60 are entirely of the fresh air variety.

FIGURE 2.—Neuwerk-on-the-Bode. This village is one of the many "fresh air health resorts," *Luftkurorte*, which attract visitors because of supposed climatic advantages.

TABLE II

PHYSIOGRAPHIC AGENCIES AND THEIR RESULTING FEATURES IN GERMANY

Physiographic Agencies	*Types*	*Resulting Land Features*	*Examples*
Ground water		Caves	
		Limestone	Ruebeland Donaueschingen
		Gypsum	Kyffhaeuser
		Sink hole lakes	
		Gypsum	Jues Lake
		Limestone	
		Sink holes	
Springs			
Ordinary	Very common		
Thermal	Wiesbaden Baden-Baden		
Mineral			
Iron	Peterstal		
Salt	Donaueschingen Kolberg		
Sulphur	Langenbruecken		
Radium	Heidelberg		
Carbonate			
Running water		Dissected topography, flood plains, mature highlands	Oden Forest Vistula delta Rhine slate highlands
Small streams	Bode in Harz Mts. Wehra		
Large streams	Rhine, Elbe, Weser		
Ice and snow	No marked glacier in land but permanent snowfield on Zugspitze	Moraines, outwash plains, lakes, islands	Moraines, parallel to Baltic. Hills around Berlin.
	Snow for winter sports		Island of Ruegen
Lakes, seas, shore action	North Sea, Baltic Sea, Schwerin Lake, Chiem Sea, Titisee	Beaches, bars islands, moorlands.	Norderney beach. Baltic beaches
Vulcanism	No active volcano	Laccoliths, lava flows, basaltic columns. Hot springs and lakes	Rhoen Mts. Eifel highlands. Erpeler-Ley columns
Crustal movements	No earthquakes	Uplifted highland and depressions	Harz Mountains Thuringia Black Forest

Regardless of what section of the country one travels through, it seems that one runs into a *Luftkurort* on every little hillock. In general, however, they are located away from cities, in places with high altitude, in forests, or beside lakes. Baden's fresh air health resorts are quite typical for the country as a whole. The official report lists as important only those *Luftkurorte* situated at more than 680 meters altitude for the Black Forest, but for the Oden Forest and Lake Constance places of lower altitude are chosen. That the Germans themselves doubt somewhat the efficacy of the *Luftkurort* is seen from the fact that the Minister of the Interior in 1932 hesitated to give either seaside resorts or *Luftkurorte carte blanche* for curative properties. The fresh air cures have their greatest flowering in summer. Almost invariably during July and August there is the heaviest trade, while in December and January, unless there is considerable winter sport, there is the least. Thus, Hardheim near Heidelberg in Baden, a typical fresh air cure, situated 271 meters above sea level, and too low for a dependable supply of snow, had the largest attendance in July and August in 1930.

Influences of Topography. Topography is another important factor creating tourist trade in Germany. It is not only necessary to offer visitors physiographic features out of the ordinary, but also a considerable variety of them. Thus, Prussia, scenically uniform, but with three-fifths of the nation's populace, gets less than half, while beautiful Bavaria, with but one-eighth of the populace, gets more than one-fifth of the 56.7 million lodgings away from home. Some classification of physiographic

features as shown in Table II, is desirable in making clear certain developments in the German *Fremdenverkehr*.

Baths or spas, particularly those of Baden, offer many attractions for tourists. Dunes and other formations caused by winds are comparatively unimportant from a tourist standpoint. Mineral and hot springs form the chief interests.

Ground Water Phenomena. Since practically all varieties of springs are found in Baden; since one of the leading spas of the world is at Baden-Baden; and since Baden-Baden with but 30,000 inhabitants had over 95,000 guests in 1929, that is three visitors for every inhabitant, the province of Baden may be studied as typical of the spa regions of the land. The very name *Baden* means to bathe. Marcus Aurelius often stayed at the baths of Baden, for they were well established by early Roman times. At Badenweiler ruins of Roman baths are found in good condition. The reputed healthfulness of the baths, particularly the thermal, is to some extent of course traditional. There was a time when medicine was far less efficacious than it is now and deficiency diseases were not well understood. There are small amounts of various minerals in the thermal and other mineral springs of Baden. Bunsen, the famous chemist, found many minerals in the Baden springs. In fact, the elements caesium and rubidium were discovered in the waters of Duerkheimer springs in the Palatinate, adjoining Baden. Iodine, sulphur, carbonates, silicates, iron, manganese, magnesium, and other elements and compounds of them are found in these waters. Before thyroid difficulties were associated with the lack of iodine, goiter sufferers found relief by drinking and bathing in such waters. Even now one cannot be sure that such springs do not have beneficial effects not yet discovered by science, just as the iodine and radium emanations, such as are found in certain Badensian springs, are now known to be beneficial.

Official statistics have divided the health centers of Baden into health baths, thermal, iron, salt, sulphur; fresh air health resorts (*Luftkurorte*) and miscellaneous cures. The widely frequented thermal baths are at Baden-Baden; Badenweiler with slightly warm water; Heidelberg with slightly warm water containing very strong radium irradiations; Krozingen, near Freiburg, with water at 100° F.; Saeckingen; Sulzbach with slightly warm water but having also Glauber salts and radio-activity. At Krozingen the springs have lithium and carbonate in addition. Fewer tourists visit the so-called chalybeate springs (*Stahlbaeder*) at Bad Peterstal, Griesbach, and Rippoldsau, which are also advertised as being radio-active and carbonated, and the first of which also contains lithium. Mud baths (*Moorbaeder*) are at Rippoldsau. The Badensian salt baths (*Solbaeder*) come at least as low as the Permian strata of this section of Europe. This stratum furnishes much of the salt and potassium of Germany. Bad Duerrheim, located 703 meters above sea level, has the highest salt springs in Europe. The salt content here is not solely sodium chloride. Bad Rappenau, Donaueschingen, and Rheinfelden all have salt contents higher than 25.0 per cent, the last named being more than 30.0 per cent. In addition, there are sulphur baths between Heidelberg and Karlsruhe.

Baths and spas are also quite common in other parts of Germany. In the Harz Mountains, for instance, we find various types of mineral springs, as the chalybeate springs of Alexisbad, Altenau, the salt springs at Lautental. Herzburg, Thale, Suderode (containing potassium chlorides also) and Stecklenberg. The

carbonated or acid springs are near Goslar and Wildemann.

Not only is ground water itself important, but caves resulting from ground water action also attract tourists. Limestone caves are found in several places in Germany. In the Jura Mountains in the south towards the headwaters of the Danube there are many limestone caves and sinkholes, a veritable karst topography. Ruebeland and Grund both exhibit caves in the Upper Devonian limestone of the Harz, while at Scharzfeld in the Harz there is one in later limestone. More unique to the country are the many gypsum caves. These apparently do not form either stalactites or stalagmites (tropfsteine), nor crystals, such as are usually found in limestone caves. The gypsum caves dissolve differently from limestone and present a very dissimilar appearance. The largest of these is in the Kyffhaeuser Mountains, the Barbarossa Cave, while others are found at Uftrungen, Rottleberode, Questenburg, Osterhagen, Werne, Steigerthal, Tettenborn. Sink holes in gypsum have formed lakes near the Harz in such places as Seesen, Harzberg, Rossla, a tunnel at Ellrich, and other effects. All varieties of caves and sink holes are very popular with tourists.

Running Water Phenomena. Running water also has played an important part in producing amusements for *Fremdenverkehr.* On the larger streams boating is popular, along the smaller, fish of various kinds are found as well. Just as in the Black Hills of America fishing for trout draws tourists, so it does in Germany. In the official reports for the province of Baden for 1930, trout (*forellen*) and "other fish" are listed. Besides providing fishing and swimming, running water in its effects has presented a dissected topography, such as the Oden Forest, which is a rendezvous for tourists. Flood plains also have scenery that is attractive, such as at Marienburg on the delta of the Vistula.

Effects of Glaciation. Although there is no glacier in Germany, features resulting from the ice ages are very important for tourist purposes. There is, of course, a permanent snow field near Zugspitze, the highest peak of the land, but those seeking amusement on glaciers must go to other countries. Topographic results of glaciation, however, are more significant for tourist trade. While moraines with their round-topped hills draw some visitors, they are of secondary rank. But the most important lakes are glacial in origin. The Masurian lakes, those of the Free State of Mecklenburg, those in the vicinity of Berlin, Chiemsee and similar lakes in Bavaria, Titisee in the southern Black Forest, every one an important tourist center, are all glacial lakes.

Effects of Large Bodies of Water. All large bodies of water draw visitors because of beaches and other features. The popularity of the Baltic and North Sea resorts attest to this influence. Seaside resorts get a very large percentage of the *Reich's* tourist trade. In the fiscal year, 1927–8 (April to March) there were 4,238,000 visitors at Baltic resorts; 1,978,000 at those of the North Sea; while only 918,000 tourists visited the Harz Mountains during the same period. This gives one an inkling of the popularity of seaside resorts with the Germans. The reason that the Baltic has such a tremendous vacation trade is in its freedom from tidal effects, and its uniform sea level. However, even the North Sea with its fluctuating shore line is a resort of considerable magnitude.

Volcanic Phenomena. Although there are no active volcanoes in Germany at the present time, their resulting fea-

tures in the Rhoen Mountains, the Eifel highlands, and the Erpeler-Ley columns on the Rhine attract tourists. Some lakes and hills arousing great interest in the Eifel highlands are the result of vulcanism. However, all of these manifestations are small. Hot springs are, of course, caused by volcanic actions. Wiesbaden, already used as a spa by the Celts, which attracted 151,841 guests in 1929, draws visitors because of such springs. The volcanic beauties at Erpeler-Ley, visible to all taking the Rhine river trip, are considered important enough to cause the formation of an "Organization to Protect the Erpeler-Ley."

Diastrophic Phenomena. The mountains of the country are caused largely by crustal movements, and this, then, indirectly creates opportunities for the tourist trade. The Harz, the Thuringian forests, the Rhine trough (a rift valley), the Black Forest, and other highlands of the land are sharply set off from other areas lower in altitude on at least one side because of geological crustal movements. In the Juras, extending from Switzerland into Germany, the mountains are largely folded as are the Appalachians of eastern United States. Crustal movements are vital in creating *Fremdenverkehr*, for the above mentioned regions are among the most scenic and are therefore the most frequented. The Black Forest and the Harz, to mention only two, attract about a million and a half visitors in any twelve-month period.

Not only are individual physiographic features vital, but combinations of several or all operate to stimulate *Fremdenverkehr*. For instance, in the Harz we find canyons, caves, rapid streams, cliffs, natural lookouts, and other enticements. And these physiographic features are further supplemented by certain organic geographic features such as animal and plant life of ranking importance.

Fauna. The fauna of Germany are utilized to draw tourists to some extent. The hunter finds opportunities for sport, although the amount is not commensurate with that of the United States. Deer, wild swine, chamois, partridges, pheasants, and water fowl are some of

FIGURE 3.—The gate of the city wall of Holzminden-in-the-Solling. The shingles of both roof and walls are of beautiful purple sandstone.

the animals finding their way into the German hunter's bag. Fishing is of some interest to vacationists there, for the German loves to eat fish. The Baltic and North Seas provide opportunities for this sport, as do all rivers and lakes. Modes of fishing are somewhat different there, traps being used to catch the popular eel, and fly-casting for trout. The official bulletin on tourist trade for Baden considers trout and other fish important enough to enumerate as one of the twelve major attractions for tour-

ists at the Baden resorts. In the Harz Mountains wild birds are tamed for sale to visitors. Wild creatures are so tame at some of the resorts that they can be fed by hand, as can the famous gulls of Berlin and the bullfinches of Potsdam.

Flora. The plant life of the country functions as a minor aid to tourist trade. Aside from some virgin forest and heath in the Harz, and the heather of the *Lueneburger Heide,* there is little aboriginal plant life to entice the visitor. Until the government took over scientific forestation the nobility were the main defenders of the native plant and animal life. Today scientific forestry has made many areas of the country attractive artificially. Thus, the once dominant deciduous forests have been largely replaced by coniferous varieties. The Douglas fir, native to western North America, has grown twice as rapidly there as other varieties planted, and trees like the American red oak, Japanese larch, and the maple are being tried. No doubt this variegation will add a great deal to the scenic attractiveness of various mountain resorts. The importance of forests to Germany lies not so much in the commercial values, but in their attractiveness to visitors. Germans travel long distances to see trees in bloom. They will watch the blossoming of the almond, cherry, plum, blackthorn, apricot, peach, nectarine, and tulip; and the flowering trees of Potsdam always are popular with guests. There is even a special festival each spring at Werder, near Berlin, during the apple blossom season. To this festival people flock from all over the country and river boats of the Havel and Spree give reduced fares for it.

HUMAN FACTORS

Although historic treasures are artificial, they are influenced by geographic factors. Topography has influenced the types of historical treasures available. The castles along the Rhine, for example, are largely on cliffs. On the plains castles were frequently placed on islands of rivers and if not, artificial islands were created by moats or canals. This was done at Brunswick, and as early as 1459 at Ruegenwalde, Pomerania. Building materials were also affected by the topography of a region. The old churches of Freiburg and Heidelberg were made of local sandstone, red in color. Slate was used in sections of the Rhine slate hills. In the Solling hills thin sheets of purplish sandstone were used to cover the sides and roofs of houses. Where there was no stone available, wood, brick, or stucco was substituted. In some scenic regions, like Wernigerode, wood was popular for constructions, and Clausthal-in-the-Harz has the largest wooden church of Germany. Sometimes historic features, like the old Roman baths at Badenweiler, attract visitors. Museums are generally the geographic and historical repositories of a region. Nearly every German town and village has a museum, and metropolitan centers, like Berlin, Dresden, Munich, Hamburg, have world-renowned galleries and museums.

A different type of artificial attraction, but one also drawing thousands of visitors, is the commercial fair (*Messe*). The one at Leipzig is the leading German example. Although most *Fremdenverkehr* occurs in summer, in Leipzig the peak month for tourists is March, which coincides with the month of its largest *Messe*.

In addition to fairs, industrial attractions often draw travelers. Despite grime and dirt the Ruhr cities are visited by many tourists. People from other lands are quite likely to consider worthwhile a visit to a chemical plant at Mann-

heim or to a publishing establishment at Leipzig, for example.

While the size of a city is important in attracting commercial passenger traffic, size does not necessarily make for great numbers of tourists. When traffic to any city is unusually seasonal one can say that it is tourist trade rather than utilitarian passenger traffic. Berlin, the largest city, is not important from a tourist trade standpoint, even though it had in 1929 the largest number of visitors of any city in the land. Berlin visitors are not in general tourists, for there is little seasonal fluctuation evident. On the other hand, Munich, fourth largest city, which ranked second in the number of visitors in the same year, shows a distinct seasonal variation in the number of visitors. Munich has less than one-third as many visitors in the slackest month as in the best, whereas Berlin had almost two-thirds as many at ebb as at flow tide. In Munich physiographic features, such as accessibility to the Tirol, tend to make August the best tourist month. Baden-Baden, with baths and gaming facilities, had but one-tenth as many visitors at ebb as at flow tide. The city with but 30,000 inhabitants, had over 95,000 guests in 1929, that is it had three visitors for every inhabitant, while Berlin had but one visitor for every three inhabitants. Of 125 cities reporting together an increase of 4.4 per cent in their 1933 tourist trade over that of 1932, only 30 were big cities, while 43 were typical tourist cities, 36 health resorts, and sixteen seashore resorts. It becomes apparent that size of cities is but a relatively minor factor in the development of tourist trade.

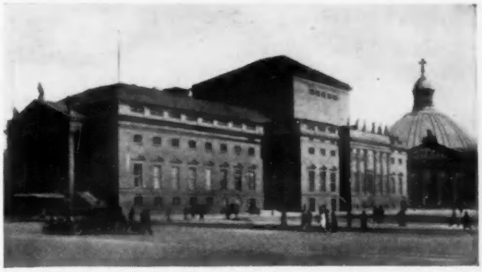

FIGURE 4.—State-owned theater at Berlin. It is especially used for grand opera, which attracts many visitors to Berlin and other large cities.

IMPORTANCE OF TOURIST TRADE

Germany's Rank. Germany does not rank as high as some other countries in the fostering of tourist trade, particularly that from foreign lands. Figured on a per capita basis Switzerland easily leads with an income from foreign tourist trade of no less than 90 marks per annum, France, 36.8; Austria, 28.5; Italy, 14.7; the United States, 6.7; Germany, 4.4 marks. Germany's ability to attract foreign visitors is rather low compared with other countries. However, Germany's foreign visitors contribute but a fraction of the income the country derives from tourists. For example, only 851,000 of the 5,426,000 visitors in twelve selected German cities in 1929 were foreigners. In Baden, of the 1,584,000 tourists in 1930 only 206,000, or 13.1 per cent, were foreigners. That the internal tourist trade is tremendous is further borne out by Germany's remarkable showing in rail passenger traffic, which exceeds, or nearly exceeds, that of any other country in the world.

Effect on Trade Balance. Foreign tourist trade affects the German trade balance neither favorably nor unfavorably. Expenditures by foreign guests constitute an invisible export. Borman estimates the *Fremdenverkehr* to be worth 400–500 million dollars annually even in lean years and that foreigners spend about one-half of that sum. Nationals of other countries spent 209 million marks in Germany in 1926, 240 million marks in 1927, 275 million in 1928, and 280 million marks in 1929.

Needless to say, this means making some profit on foreign visitors. However, she does not gain a favorable balance of trade from the tourist trade, chiefly because her own people spent abroad 200 million marks in 1926, 260 million in 1927, 275 million in 1928, and 280 million marks in 1929. In order to create a more favorable balance, the Nazi régime has put a visa fee of 1,000 marks for each traveler in the case of tourists going into Austria. In 1926 Germany had a favorable balance of 9,000,000 marks, but in 1927 an unfavorable one of 20,000,000. In 1928 and 1929 neither a favorable nor an unfavorable balance was recorded. Thus, we may say that Germany's foreign tourist trade is profitable, although not so much so as that of some other European countries. Actually it would have been fortunate for the country to have had a very favorable tourist trade balance each year, for then the dangers involved in meeting the payments of reparations would have been partly avoided. The chief danger of reparations payments both to Germany and to the world at large was that it forced upon her a generally unfavorable balance of trade.

A Consuming Industry. The fact that a tourist industry is a consuming industry is significant in times of overproduction. At a time when there was danger of underproduction, tourist trade could be called a luxury. At the risk of oversimplification one may briefly say that in times of overproduction as compared to underconsumption, tourist trade, essentially a consuming industry, will go far towards decreasing overproduction. This important fact was overlooked in German recovery plans during the depression.

Tourist trade utilizes areas which would otherwise not contribute to the land's total wealth. There is ordinarily a strong tendency for wealth to drift into large cities. Since there is much tourist trade in places essentially rural, this offsets the drift of wealth to urban centers, and tends to create wealth in regions not fitted for much else. Tourist trade certainly puts to use some of Germany's most barren reaches, sandy slopes, barren hills, ground shot through and through with sink holes and caves, mountain tops not capable of producing much except a supply of snow. Tourist trade thus aids in preventing an economic vacuum.

Not only is Germany geographically well equipped to develop an important tourist trade, but the country was alert to the possibility of a scientific approach to its study. Consequently, today Germany almost leads the world in rail passenger traffic, which is in a large measure due to a conscious development of a particularly strong internal tourist trade. In a study of German tourist trade the geographical aspects appear to be particularly vital.

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